FOOD MANUFACTURE

Incorporating Food Manufacture Weekly

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A JOURNAL DEVOTED TO THE PRODUCTION OF ALL EDIBLE COMMODITIES INVOLVING A PROCESS OF MANUFACTURE.

FOOD MANUFACTURE

Incorporating Canning, Packing and Preserving

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The Editor will be glad to consider contributions from those engaged in the Food Industry. Articles intended for publication should be of a practical nature and accompanied by photographs or drawings when possible.

Lord Woolton, the Minister of Food, stated that the rats of this country, estimated at 40,000,000, devour or damage £1 worth of food and property per head every year. He laid a solemn obligation upon everyone to rid NOW the country of rats.

Rats cost Britain £40,000,000 a year

You know that quick-acting poisons and traps destroy only too few, drive off the remainder . . . that they quickly return. That is the danger of unscientific methods. Their *natural suspicions* are aroused by the speedy fate of their fellows. They avoid poison and traps and live to rob and destroy. Moreover, everywhere these filthy and loathsome pests go, they leave a trail of dreadful maladies.

At a time when the country's very existence is at stake, it is fantastic that the filthy pests should be tolerated for one moment. Time then is vital. These 40,000,000 enemies in our midst must no longer be allowed to play the Nazis' game: destroying our food reserves and undermining the health of the nation.

It has now become a national duty for you to do your part towards wiping out so foul a menace. Act *now!* Let RATIN . . . the *scientific* method of destroying rats, do it without arousing the rats' suspicion. Rats suspect poisons and traps: but *not* RATIN—they eat it *eagerly* and soon they die. With all their cunning they do not realise what is killing them, nor do the deaths warn the rest of the horde.

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There is no care and attention too great to be paid to its design and manufacture. Like the hat on the human head, it must suit the shape and style of the head of the jar it has to fit.

Problems such as these have been Wallis's work for years. To manufacturers faced with package changes, Wallis offer the benefit of long experience and scientific production facilities.

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I.J.W.

Facing first page of Editorial

FOOD MANUFACTURE

Vol. XVI, No. 6 June 1, 1941

The Potato in Industry

INFORMATION filtering out of Germany reveals a determined effort to replace cotton and wood pulp by cellulose extracted from potato tops. This method of turning to account the great annual accumulation of potato tops was bound to attract a country with a gigantic potato acreage at a time when she must be seriously concerned about her supplies of cellulose for the paper, rayon, explosives and other industries. The economics of the business will naturally be ignored by the Nazis, who are solely interested in the possibility of an annual yield of 500,000 tons of high-grade cellulose, this being the maximum figure indicated and one which cannot be reached immediately.

To turn to the potato proper, this has, of course, been long exploited as a source of starch. The latter is largely used as such for adhesives, or may be subjected to more or less far-reaching molecular degradation to yield glucose and alcohol. Intermediate products are the well-known cold-water starches. Many esters of starch have also been prepared, such as nitro-starch, starch acetate, starch propionate, etc., but do not appear to have found extensive use. Among the patents granted in the past year is one for the production of high-viscosity potato starch derivatives by reaction with beta-beta^1-dichloroethyl ether. These products are used in making cold-water printing pastes for the textile industry. Another patent describes the production of high-grade glucose by acid hydrolysis of potato starch which has been completely freed from soluble mineral matter by exhaustive washing with pure water.

A Chinese Insecticidal Plant

From time immemorial the peasants in the Chinese province of Chekiang have used a most effective insect destroyer for dusting on to the leaves of their cabbages, cucumbers, and carrots in the shape of the powdered root of a perennial twining vine known as "lei kung teng" (or "thunder god vine"). The botanical name of the plant is *Tripterygium Wilfordii*, and there is every prospect of it coming into use in the Western world now that it has been successfully cultivated in the United States. Since 1935 American scientists have been engaged in cultivating the plant from Chinese cuttings, and an account of the tests made to confirm the claims of Chinese scientists is published by W. T. Swingle, of the United States *Journal of the Bureau of Plant Industry in Science*. Preliminary experiments with root powder derived from plants grown in China were discouraging because the powder steadily declines in insecticidal activity when stored and becomes useless after twelve months. It was not until September, 1939, that fresh powder from the American-grown plants became available for extended trials. When tested against the larvæ of the codling moth by the apple plug method, the fresh root powder was found to give about 60 per cent. of clean fruit when used at the rate of 2 lbs. per gallon of solution. Still better results were obtained with the alcohol extract of the fresh root (2 lbs. extractives per 50 gallons of solution), which gave 90 per cent. clean fruit. When dusted on to leaves, the powder acted as a repellent to the Colorado potato beetle larva and other larvæ. The results were impressive enough to warrant an exhaustive chemical investigation of the plant extractive, and data on the toxicity of various fractions will shortly be published.

[c]

"Fortification" of Bread

Bran layer removal from flour by sifting is a practice only 5,000 years old! People also remove egg shells, orange peel and pea pods. The American public ate white bread even before the roller mill and purifier. And why standardise at whole wheat nutritional levels? The foregoing will indicate the trend of a spirited article by Oscar Skovholt, of the Quality Bakers of America, New York, published recently (*Food Industries*, March, 1941).

It is the consuming public's greater acceptance of the more refined food rather than crude foods which is responsible for the manufacturers' heavy investment in the processing equipment that now receives unwarranted censure, says the writer. With regard to wheat germ, competent millers have expressed the opinion that buhr-stone grinding methods make germ retention in sifted flours more difficult than the use of roller mills. In the debates for or against restoration of white flour to whole wheat nutritive levels, many make the error of assuming that diets of 60 to 100 years ago included only bread of the whole-wheat type. That assumption is wrong. The writer makes the important point that no industry should assume that the last facts are known about any phase of nutrition. Dr. McHenry, a well-known Canadian dietitian, speaking recently in Toronto, hoped that in Canada some solution other than that of adding one or two vitamins after removing eight or more would be found. Anything less must be considered a defeatist attitude on the part of research workers.

From two points of view these two scientists work to the same conclusion, and we feel that there may be a definite danger, once the tumult and the shouting dies, of allowing dietetics to relapse into the rut from which it has been dislodged by the jolt of war.

Mountains of Knowledge

The accumulations of published work in the vitamin and allied fields can of course be paralleled in most branches of scientific activity. In the food industries it is becoming increasingly more difficult to keep abreast of all developments, even when aided by such admirable publications as British Chemical Abstracts and the Abstracts of the Imperial Bureau of Dairy Science. Many workers, especially research workers, appreciate the need for spending a considerable proportion of their time in library research. In this ambition they may be heartened by the example of Dr. Casimir Funk, who laid the foundations of vitamin science in 1912, not so much by laboratory experiments as by an assiduous study of the existing literature on what we now call deficiency diseases. This led him to the hypothesis that infinitesimal traces of certain constituents of foodstuffs hold the balance between health and disease. The labours of library research scientists are perhaps less appreciated in this country than on the Continent and in the United States. But even in the latter country the tendency to concentrate on laboratory work to the relative exclusion of library research is very prevalent, if we may judge from the fact that some 30,000 patent applications are annually rejected, mainly on the ground that the subject-matter had already been described in published literature.

Detection of War Gases in Foodstuffs

The British Association of Research for Cocoa, Chocolate, Sugar Confectionery and Jam Trades issued a pamphlet in April, 1940, on the Identification and Determination of War Gases in Foodstuffs based on the information then available in the published literature. Subsequent discussions with the Ministry of Food and the Chemical Defence Division of the Ministry of Supply have now resulted in the revision, with the approval of these Ministries, of this pamphlet by W. J. Stainsby, Ph.D., A.I.C., and A. McM. Taylor, B.Sc., A.I.C., of the Research Association.

The full text of the pamphlet is published in *The Analyst*, 1941, **66**, 44-54. A clear scheme of analysis is drawn up and the precautions to be taken both chemically and to avoid contamination are given. The material in the pamphlet is considered under the headings: General Considerations, Scheme of Analysis, Subjective Examination, Airflow Analysis, Examination of an Alcoholic Extract of the Sample, Examination by Determination of Elements, Grouping of War Gases and Confirmatory Tests.

In view of the need of close and continued vigilance against the effects of gas attacks and their effects every foodstuff chemist should study this paper.

B Vitamins and Plant Growth

Until recently the number of published investigations in the vitamin field averaged about three per day. A vast expansion in the already formidable bulk of vitamin literature is inevitable now that agricultural chemists are collecting data upon the influence of vitamins upon plant growth. A good deal of work has recently been carried out, for example, in connection with various members of the B family, some of which is not without interest to vegetable and fruit growers. Nicotinic acid (the anti-pellagra factor) and vitamin B_6 both appear to be essential to good growth of isolated tomato roots, while the former acid and vitamin B_1 were growth stimulants of isolated roots of alfalfa and clover. At least three factors—nicotinic acid and vitamins B_1 and B_6—function as growth stimulants of sunflower roots, whereas nicotinic acid is not an essential factor in carrot-root growth, which is stimulated only by vitamins B_1 and B_6. Of biochemical interest is also the observation that conversion of glucose to sucrose by the aerated excised roots of the sugar-cane is greatly stimulated by riboflavin. The latter was more effective than vitamin B_1, while ascorbic acid takes up an intermediate position.

Coffee Plastics to Compete with Synthetic Resins

Since our note on coffee plastics (Food Manufacture, January, 1941) the announcement has been made of the formation of a company to place Brazilian coffee plastics on the United States market. We understand (from *British Plastics*) that a pilot plant with a through-put of 50,000 bags of coffee (132 lbs. each) a year was scheduled to start production early this year, while a second and much larger unit capable of dealing with no fewer than 1,000 bags a day was to be started up last month. Both plants are controlled by the Brazilian Government and are located in Sao Paolo.

The method of processing of the green beans is believed to involve reduction to powder, solvent-extraction to remove caffeine and other valuable by-products, and treatment of the residual powder in an autoclave until resinification takes place as a result of complex interaction between the aldehydes, tannins and proteins in the beans. The new plastics are intended to compete with the phenol-formaldehyde moulding powders, which are comparatively dark in colour. Moulding powders made from phenol-formaldehyde resins generally require the addition of a cellulosic filler such as wood flour. In the case of the coffee plastic, however, the filler is already present in the shape of the fibrous constituents of the bean.

Separation and Identification of Sugars from Mixtures

Among the papers presented at the April 7-11 meetings of the American Chemical Society was one by Charles D. Hurd, K. M. Gordon and R. W. Liggett on the above.

In the attempt to develop methods for the separation and identification of sugars in mixtures several derivatives have been studied. The indirect methylation procedure (1938) is suitable for analytical separation by vacuum distillation of mixtures of mono-, di- and tri-saccharides, but has not been found capable of development for further separation within these groups. Study procedures involving crystallisation or osazones, triphenylmethyl ethers, acetyl derivatives, and others have not proved satisfactory. Trixenylmethyl ethers of xylose, glucose, galactose, maltose, lactose, and trehalose were prepared. All are crystalline solids, but these derivatives also were ineffective in helping to separate mixtures.

Satisfactory separations have been achieved by means of completely propionylated derivatives of sugars, prepared by action of propionic anhydride and pyridine on the sugar. Several of these propionates (maltose, sucrose, xylose, arabinose) are readily crystalline. All are distillable at low pressures (0·01 to 0·0001 mm.) in a special apparatus, even raffinose hendecapropionate. Since the propionyl group can be cleaved, after distillation, into appropriate fractions without rupture of the glycoside linkages, it is possible to convert non-crystalline propionates into other crystalline derivatives. Investigations of such mixtures as acid-hydrolysed corn syrup, hydrol, malt syrup, etc., have already given fruitful results with this method.

Naked Oats

Naked oats, according to Gerarde, writing in the sixteenth century, "are like unto comon Otes, differing in that, that these naked Otes immediately as they be threshed without helpe of a mill become Otemeale fit for our use". The cereal appears to have been much cultivated in his time, and Gerarde adds: "Some of those good huswives that delight not to have store of anything but from hand to mouth . . . may (whiles their pot doth seath) go to the barne and rub foorth with their hands sufficient for that present time."

By the latter part of the seventeenth century, however, the plant, *Avena nuda* Linn., appears to have gone out of general cultivation. Charles Bryant, writing about it in his *Flora Diætetica*, published in 1783, states that "in former ages this was the chief *Oat* cultivated here, for the needs being naked was a great inducement to its propagation, before the method of hulking the Common Oat became general, as when they were boiled, they turned for the most part into flour".

During the Napoleonic wars the cultivation of the plant was revived as a war-time measure for the production of a substitute for wheat which could be grown on poor soils. Thomas Green gives a good account of it in his *Universal Herbal*, vol. i, published in 1820. Cultivation appears to have been principally undertaken in Cornwall, the North of England, Scotland and Wales, and the grain was known as "pillis", "pilez" or "pill-corn". "An acre of ground," writes Green, "does not yield so many bushels of these, as of the common oats, because the grain is small and naked, and goes near in measure; but what is wanting in the measure, is supplied in value."

Judging from all accounts, the meal of naked oats would appear to have more the character of a coarse wheat-flour than that of oat-meal, while the straw is said to be finer than that of the ordinary oat, and almost as good as fodder. In Cornwall the cereal is said to have been grown as the last crop of an exhausting rotation.

Would reintroduction of its cultivation be a useful war-time measure? The question is possibly worth consideration. *Avena nuda* was growing at Kew in 1925, and possibly is still in existence there, though we are uncertain whether the Kew strain represents the most suitable one for cultivation.

Roller Drying of Whey

For certain purposes it is necessary to produce roller-dried whey from cheese whey which has been brought as near as possible to the neutral point. A paper dealing with problems involved in the drying of such neutralised cheese whey and the parallel problem of the neutralisation and drying of whey which is formed as a by-product in the manufacture of acid casein, by R. Waite, of the Hannah Dairy Research Institute, has been published in the *Journal of Dairy Research*, 1941, **12**, 1. The author summarises his work by saying that in experiments dealing with the best method of neutralising cheese whey prior to drying by the roller process, the use of sodium or potassium compounds leads to difficulties in drying and the production of an unpalatable product of poor quality. Neutralisation with calcium hydroxide gives a satisfactory product, but over-neutralisation must be avoided. Complete neutralisation of hydrochloric acid casein whey results in the formation of a flocculent precipitate and deterioration of drying properties; reduction of the acidity from 0·48 to 0·18 per cent. by the addition of calcium hydroxide allows successful drying and yields a satisfactory product. The latter is, however, definitely unpalatable. Acetic acid casein whey can be dried without any previous neutralisation to yield an excellent and palatable product.

Quick-Freezing of Cooked Meat

Quick-frozen pre-roasted beef is now being shipped to the United States in small quantities for the restaurant trade and home consumption, and is reported to have gained favourable acceptance in New York City, says the *National Provisioner*. Developed as an answer to the United States Customs ban against the importation of fresh meat from Argentina, the roasts are cooked between three and four hours in an oven at a minimum temperature of 212° F., ensuring thorough cooking of the centre at 156°. Following removal from the oven, the roasts are wrapped immediately in Goodyear Pliofilm of 170 gauge, normal type. An overwrap of tough paper is then applied and the roasts are packed in wooden boxes, about six to a box. Next they are transferred to a freezer, where they remain until placed in the refrigerator compartment of a steamer for shipment. Results show no loss of flavour, oxidation, discoloration or absorption of foreign odours, and the meat is protected against loss of weight through moisture evaporation. A ten pound roast will defrost at room temperature in one day, after which it may be re-heated or sliced and served cold.

Canned Goods on Scottish Market

Indications that further supplies of the "old favourites" in the canned goods world have been released to the trade and thence to the public have been evident this past month, and some of the retail shop windows are now decorated with Heinz products.

In this connection a prominent canned goods distributor indicated to us that there was a very considerable amount of hoarding in such lines in the areas he was best acquainted with, and that quite respectable stocks were being held by individual housewives, who are buying but not using the canned stuff they buy. "Many of them were badly disappointed when they found that old favourites were not obtainable, and appear to be determined to lay in a store against such a contingency again. It appears that many buyers have become so accustomed to the particular flavour of one maker's brand that they regard that as a standard and accept all others as merely imitations. Obviously when such brands do appear in the shops they are snapped up and soon become again unobtainable. He instanced a particular type of baked beans in this connection. A perfectly attractive can of beans sold by a Scottish canner retained the flavour of the beans rather than the flavour of one ingredient—in this case tomato sauce. As a result, many complained that the beans were bad—an example of one type of product having standardised a market.

Stocks appear to be mainly vegetable-and-meat, meat-and-paste type products, with little fruit; in the total, however, these stocks, he considered, would form a very substantial reserve.

Irish Brands

A feature of present war-time canned goods marketing has been the decided invasion into new territories of Irish canned products. Not the least important of these is the famous Irish stew, which is making its appearance for the first time. Packers in both Northern Ireland and Eire are exporting, and a very ready market has been found for all they can offer.

These brands may retain a foothold on the market after the war, as they are well up to the standard of English or imported meat packs, and have a distinctive flavour which is proving popular.

Typical brands of this type are Irish stew dinner and stewed steak, prepared and packed in Eire for a London firm of wholesalers. "The popularity which these brands have achieved in the short time they have been seen in the particular area I write of," says a Scottish reporter, "indicates a big market for the ready-prepared meat-and-vegetable pack."

Another comparative newcomer to certain British markets is canned tuna, which food dealers are now pushing as an alternative to salmon where that is not available. Empire-packed brands of tuna have been sold freely, canning distributors report, and interest in the tuna flavour is being evinced.

Chocolate Firm Wins Appeal

The First Division of the Court of Session, Edinburgh, on an appeal by the defenders, recently overturned a judgment by which Lord Russell last August awarded £800 damages to a woman in an action against a chocolate manufacturer. The complainant had claimed £2,500 as damages in respect of injuries sustained by her through swallowing a piece of safety razor blade which, she averred, was contained in a chocolate.

Lord Russell had held that the presence of the razor blade in the chocolate could only be accounted for by absence of care on the part of some employee of the manufacturer.

Lord Normand, the Lord President, giving the leading opinion, said it was impossible to say that the pursuer had proved that the metal and chocolate were brought together in the factory rather than in her own shop or house. In his opinion the balance of probability inclined the other way, because in the factory special care against such accidents was part of the routine, whereas in the pursuer's premises no such special precautions were taken.

Accordingly, no question of the defenders' negligence arose, and he moved that they should assoilzie the defenders.

Optimum Calcium Requirements

In the April issue of this journal were given some details of the criticisms of the statements of Harris, Ireland and James on Optimum Calcium Requirements. Among a number of other contentions, Dr. Harris, replying to his critics in a letter to the *B.M.J.*, states that large retention of calcium is a peculiarity of middle age, and asks of his critics what is the percentage of adult population who suffer from calcium deficiency which cannot be detected by any known method, clinically or in the post-mortem room? He also appeals to the Medical Research Council to pause before committing themselves to the criminal folly of adding calcium to bread. He does not, however, convince the *B.M.J.*, whose editorial note states that in their leading article of February 22 it was made plain that in their opinion the proposed addition of calcium to flour in war-time was a sound nutritional measure, and furthermore that they entirely disagree with Dr. Harris's opinions. And here the matter rests for the present.

FRUIT PRESERVATION IN HAMPSHIRE

Tucked away in a small Hampshire town is the jam and fruit preserving factory of J. Long, Ltd., one of the many examples of old-established British food enterprises

THE FIRM of J. Long, Ltd., is still another of those old-established food manufacturing concerns which have carried on throughout the economic rain and shine of the past sixty years.

Founded in the year 1880 by the late Mr. J. Long, it was floated as a public limited company in 1910. The present board of directors consists of Mr. George Long (Chairman), Messrs. H. Ford, W. H. G. Filmore and Miss A. Long.

Mr. George Long has been Chairman and Managing Director of the Company since 1923. Although he takes the keenest and most active interest in the business, he is not one of those business men—happily now less frequently met with than formerly—who have no ideas or interests outside their business. He has travelled widely and was elected a Fellow of the Royal Geographical Society in 1924 and a J.P. in 1925, and is now Vice-Chairman of Magistrates. He is a prolific writer upon historical and topographical subjects, and a number of his books upon these subjects have been published.

Mr. George Long.

Production

In normal times the variety of goods manufactured is very large. In the jam department are made jams, fruit jellies, lemon, orange and grapefruit marmalade, and lemon curd, etc.

A useful canning section produces canned and bottled fruits, formerly under the now-abolished National Mark. Fruit drinks, including cordials and squashes and ginger, raisin and blackcurrant wines, are made in their respective departments, and there is a large aerated water department.

Another section deals with candied and drained peels, and the confectionery side is covered by the manufacture of boiled sweets and such side lines as lemonade powder and sherbet.

Many of the afore-mentioned lines have perforce been discontinued for the time being, and the principal business carried out at present is the manufacture of jam and the canning of fruits in season.

Jam Manufacture

The important item of glass jar washing is carried out in automatic washing machines which use hot water, steam and detergent. Having been efficiently washed and rinsed, the jars pass through an air drier and are delivered in small crates ready for filling. (See illustration on right.)

Boiling pans of every type are used. There are both rapid and slow open pans and several closed pans of the vacuum type.

The open pans are tinned or silvered inside, but some special pans are actually lined with silver. In one case the silver coating is one-sixteenth of an inch thick and cost £400.

The Company's raw materials almost exclusively consist of English fruit purchased direct from the growers, some of whom have supplied the Company for two or three generations.

As much fruit as possible is made up to the Fresh Fruit Standard, and the surplus fruit is pulped and made to Full Fruit Standard, the maintenance of the 68·5 per cent. soluble solids being controlled by refractometer.

Considerable quantities of sugar syrups are required for fruit canning and for the manufacture of fruit drinks, and the appearance of these articles is much improved by the use of sugar syrups of very bright colour and free from foreign matter.

For this purpose is installed a modern sugar-refining plant for the production of sugar syrups of the utmost purity.

Pectin

An enormous amount of work has been done on pectin since Bracconnot, just over 100 years ago, established that the ability of fruits and fruit juices to form jellies when boiled with sugar depended upon the presence of pectin. Among other things, it has been shown that a firm set prevents yeast from invading jam.

In the factory there is an installation for making the pectin needed for jams from those fruits which do not themselves provide sufficient pectin for satisfactory setting. The pectin is made from English apples in an autoclave having a capacity of 1½ tons of fruit. After cooking in the autoclave the material is pumped through overhead pipes to filter presses, and the filtered liquor evaporated to the necessary consistency in vacuum pans.

Solid-Pack Apples

Solid-pack canned apples, mainly for the restaurant and hotel trade, form an important item in the Company's canning activities, and successful competition has been achieved with the imported product, mainly from America.

Bramley apples are peeled and cored by machine and immediately placed into tubs of brine to prevent them from turning brown. The brined apples are carefully examined for traces of peel, etc., and are then cut into pieces. To remove the salt of the brine the pieces are placed into wooden crates and passed through a tank of hot water, at the end of which they are lifted out and their contents packed into 6½-lb. tins. When the tins are full the contents are pressed to eliminate excess water.

From the packing tables the tins pass through an exhauster of the steam-heated type, and from thence to the seaming machine, and finally they are sterilised.

A large variety of fruits canned in syrup, and bottled fruits, are also made during the season.

Cider Manufacture

Cider-making is another of the Company's activities. Three brands of apples are used—sweet, bitter sweet and sharp; in such combination they give the characteristic tang so much appreciated by lovers of the beverage.

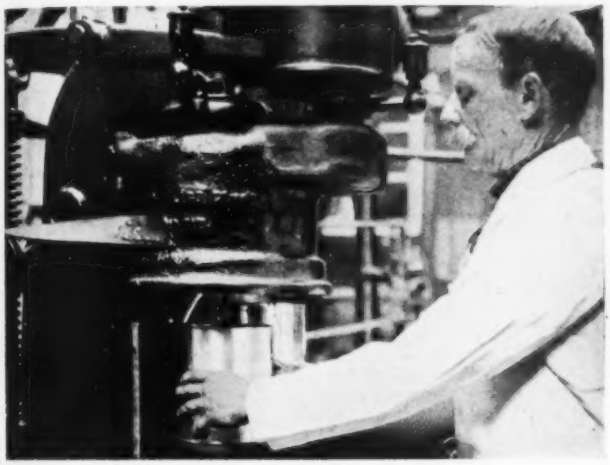
Until comparatively recently cider tended to be sour, due to the conversion of alcohol into acetic acid by the *Bacterium xylinum*, and it was found that this acetification is caused by undue access of air to the product. The improvement of cider in recent years is due to—

(*a*) Better treatment of fruit to prevent acetification before the fruit is milled—*i.e.*, prevention of heating in the bins or outside stores.
(*b*) Processing improvements designed to increase factory hygiene in general and to prevent air access in particular.
(*c*) Use of fermentation locks during fermentation, to keep air away from cider after first main fermentation is over.

Cider is bottled in the extensive bottling department, which also handles the various cordials and aerated drinks made.

Apple Peeling Machine.

Discharging a "boil" of jam.



Double seaming tins of solid apple-pack.

Starting up a retort for pectin manufacture.

Vacuum evaporation of pectin liquors.

Jar Capping Machine.

Power, etc.

Power is provided by two large Cornish boilers fitted with Turbine Patent furnaces.

Deliveries of goods are effected by the Company's own fleet of motor lorries, which are serviced in their own repair shops.

SOME SUPPLIERS TO J. LONG, LTD.

Electric Motors : *Crompton Parkinson, Ltd.*
Filter Presses : *S. H. Johnson and Co., Ltd.*
Jam-Boiling Pans : *Wm. Brierley, Collier and Hartley, Ltd., and Charles Skerman and Sons.*
Sweet Machinery : *Wm. Brierley, Collier and Hartley, Ltd.*
Fruit Pulpers : *Wm. Brierley, Collier and Hartley, Ltd.*
Gooseberry Snibbers : *Wm. Brierley, Collier and Hartley, Ltd.*
Black-Currant Striggers : *Wm. Brierley, Collier and Hartley, Ltd.*
Mincer for Mincemeat : *Wm. Brierley, Collier and Hartley, Ltd.*
Peel-Cutting Machines : *Wm. Brierley, Collier and Hartley, Ltd.*
Peel Cutters : *Wm. Brierley, Collier and Hartley, Ltd.*
Semi-automatic Double Seamer : *The Metal Box Co., Ltd.*
Apple-Peeling Machines : *Mather and Platt, Ltd.*
Water Pumps : *Worthington-Simpson, Ltd.*
Two Simplex Bottle-Washing Machines : *R. Powley and Sons, Ltd.*
Scales : *W. and T. Avery, Ltd.*
Colours and Essences : *Stevenson and Howell, Ltd.*
Colours : *Williams (Hounslow), Ltd.*
Capping Machines : *Sure Seal and Sutax, Ltd.*

FLAVOURING ESSENCES AND EMULSION FLAVOURS

Specially Contributed

OWING to the high potency of the majority of aromatics used for flavouring, whether natural, such as essential oils, resinoids, etc., or synthetic, for most practical purposes they have to be diluted and used in the form of " essences ". When required for flavouring such products as fish and meat pastes, a fixed vegetable oil, such as arachis oil, commends itself for use as the best solvent. But for general use " essences " made with fixed vegetable oils are quite unsuitable; and, from the technical point of view, pure ethyl alcohol diluted with pure water is a solvent so admirably adapted for use for the purpose that no search for any alternative would ever have been instituted but for the fact that alcohol is dutiable and hence, instead of being one of the cheapest solvents on the market, is one of the dearest.

Non-Alcoholic Solvents

Unfortunately, practically all other solvents for aromatic products suffer from one or other of the following defects: (*a*) insufficient solvent action, (*b*) unpleasant taste or aroma, (*c*) toxicity.

In a contribution to the subject by Redgrove, published both in this country and in America,* it was suggested that the problem might be solved by using flavouring materials in the form of o/w emulsions. A short summary of work done in this direction in 1929 by Whitmore and Lineham was given; and Redgrove stated: " In my opinion there is here a field for further research having as its object the production of tasteless and flavourless edible emulsifying agents for the production of emulsion flavours."

Such a research has been conducted by Tice, of the Philadelphia College of Pharmacy and Science, and Percival, research chemist attached to Limpert Bros., of Vineland, N.J., which represents a definite advance in the technique of producing satisfactory emulsion flavours, a report of which appears in the January issue of the *American Perfumer*.

Unlike Whitmore and Lineham, Tice and Percival have not aimed at producing *transparent* emulsions; after all, transparency is a matter of quite secondary importance. They find that, when transparency is not a requisite, gelatin is a suitable colloid for the preparation of satisfactory emulsion flavours. Attention, however, is directed to the fact that there are two distinct types of gelatin: (*a*) gelatin obtained from an acid-treated precursor, and (*b*) gelatin obtained from an alkali-treated precursor, whose properties in certain respects are quite different. In preparing emulsions, the former type of gelatin must be used at a *p*H of 3·0 to 3·2, while the latter requires a *p*H of 7·0 to 8·0.

High Viscosity Necessary

A second point of importance is viscosity. Unless this is high, creaming takes place. On the other hand, if sufficient gelatin is used to prevent this by giving the requisite viscosity, the emulsion gels if placed in a cold place. It is therefore necessary to employ an alternative agent for increasing the viscosity.

The authors find tragacanth to be satisfactory, providing a suitable gelatin of the second type mentioned above is employed. Tragacanth is incompatible with gelatin derived from an acid-precursor.

These considerations have led to the devising, after preliminary experiments, of the following technique, which was found to yield excellent and stable products: A primary emulsion is formed by mixing 1 part of the flavouring material (essential oil or synthetic) with 2 parts of a 1½ per cent. solution of a suitable gelatin derived from an alkali-precursor, adjusted to approximately *p*H 8·0. To effect satisfactory dispersion a homogeniser or colloid mill must be used, as it is necessary for the oil particles not to exceed 4 microns in diameter. This emulsion is then " cut " with a previously prepared tragacanth suspension containing alcohol as preservative, and the *p*H is reduced to 5 to 6 by means of citric acid. This should be done immediately after preparation of the primary emulsion, which should not be allowed to stand.

* *Flavours*, October, 1939; *American Perfumer*, January, 1940.

A typical formula for a 5 per cent. emulsion of lemon oil, having the consistency of a thick cream, is as follows:

PRIMARY EMULSION.

Lemon oil	5 oz.
Hot distilled water	2 oz.
Pharmagel B (gelatin)	0·15 oz.
Cold distilled water	8 oz.
Caustic soda solution (10 gm. per 100 c.c.)	0·3 c.c.

TRAGACANTH SUSPENSION.

Alcohol	10 oz.
Powdered tragacanth, U.S.P.A.	2 oz.
Citric acid solution (50 per cent.)	0·3 c.c.
Water	73 oz.

The primary emulsion is formed by dissolving the gelatin in the hot water, adding the cold water and caustic soda solution, and finally the lemon oil, then agitating well until a coarse emulsion forms, and homogenising. The tragacanth suspension is prepared in the usual manner, and to this is added the primary emulsion, followed by the citric acid solution, plus colouring matter if desired.

To produce emulsions of concentrations other than 5 per cent., the proportion of tragacanth suspension in relation to primary emulsion is adjusted, with necessary adjustment in the concentration of tragacanth. This latter adjustment will partly depend on the quality of the tragacanth employed, and the proportion used should be sufficient to produce a thick cream as the final product.

Stability of Emulsions

Not only are the creams stated to be stable, but the authors add that there is no tendency, in the case of the lemon oil emulsion, for a terebinthinate flavour to develop on ageing. On dilution with syrup or water a fine permanent " cloud " is formed, which is advantageous so far as use for the preparation of soft drinks is concerned, as " cloudy " lemonades, etc., are usually preferred to clear ones.

The authors state that emulsions containing so much as 20 per cent. of lemon oil have been kept over a year without change.

Use of Corn Syrup

Another important contribution to flavouring essence production technique appears in the same journal, by Lenth, of the Glycerine Producers' Association.

As is well known, glycerine is often employed—usually in conjunction with diluted alcohol—as a solvent for vanillin and coumarin in the production of artificial vanilla essences. Attempts to use glycerine and water alone have been made, but are attended with the drawback that, if the proportion of glycerine is reduced to an economic figure, the products are liable to attack by certain micro-organisms. According to the author, this drawback to the use of glycerine may be overcome by means of corn syrup (40° Bé.). Corn syrup itself has about the same solvent action on vanillin and coumarin as has water, and, if diluted with water, is liable to ferment; but if a mixture of corn syrup, glycerine and water is made so as to have a total solid content of about 50 per cent. and a glycerine content of about 25 per cent., a satisfactory staple solvent is obtained.

The following formula is suggested:

Corn syrup (43° Bé.)	60·6 per cent.
Glycerine U.S.P.	26·3 ,, ,,
Water	13·1 ,, ,,

The true solubilities of the two flavouring materials in this solvent are: vanillin 1·19 per cent., coumarin 0·32 per cent., but if mixed the figures are higher—namely, vanillin 1·35 per cent. and coumarin 0·56 per cent. Emphasis is laid on the fact that these are *true* solubilities, because supersaturated solutions are easily formed. This fact is important, as it means that there is

(*Continued on page* 130)

THE CONTROL OF COLOUR IN FOOD PROCESSING

The object of colour comparison is to maintain a constant standard of colour from batch to batch and to provide a means of describing and defining colour for purposes of record. The author briefly discusses the methods used in the food industry.

H. W. RUDD, M.Sc., A.I.C.

THERE is a saying that when a man buys a motor-car the first thing he looks at is the engine, but that woman's first concern is with the colour. Behind this frivolous statement there lies an element of truth and much sound justification, for colour is one of the most fundamental facts of our experience. As human beings we respond to colour before almost any other exciting influence, and our experience has taught us to associate different objects with different colours. The sky is blue, vegetation is green, butter is yellow, tomatoes are generally red, and our notions of purity, either of food or ethics, are bound up with white. It is therefore not surprising that the public judges its food and other necessities by the colour, and it is the job of the food manufacturer to give the public what it wants, a task that entails difficulties and responsibilities.

Nature of Colour

Colour, besides being a fundamental conception, is also a subjective one and often a very transient one into the bargain. It has no absolute value or standard, depends for its effect on the sensitivity of the observer, his mental reactions and physical health, and very often exhibits a tantalising instability. This last property is especially pronounced with foodstuffs; food is invariably of animal or vegetable origin, and its colour is due to the presence of organic chemical compounds of great complexity produced by the plant or animal during life. If the organism becomes diseased, and also when life ceases, colour changes take place. The beautiful sequence of changes of the leaf in autumn are indications of the decomposition of the chlorophyll which accompanies the death of the leaf substance. Similar considerations apply to food, especially meat and fish, which are invariably "dead" when preserved or consumed. The changes may be postponed with vegetable food, which often continues to live and breathe long after picking. Here, then, is the first and most important aspect of colour in relation to food; to the public mind, colour is the touchstone which is applied unconsciously before every purchase, and food which offends against the popular standard may be deemed unfit for consumption. This may be an unreasonable and unfair attitude in many cases, but it cannot be gainsaid, and the man who processes food must take cognisance of it.

Preservation of Colour

The preservation of colour during processing may be considered under three heads: (1) changes occurring during the actual cooking or other process, (2) changes during the period of storage, (3) methods of assessing and standardising colour changes—the science of colorimetry. There are, of course, other aspects which are outside the scope of this article. Thus it has for long been the custom, partly dictated and approved by popular opinion, of introducing artificial colour, a practice that has given rise to many abuses. The old method of colouring canned peas with copper sulphate, now illegal, is well known. Nowadays, thanks to legislation, better practices prevail, but the use of dyestuffs and natural colouring matters, especially in the confectionery trades and for beverages, is still common. The Food Acts prohibit the use of metallic colours derived from antimony, arsenic, cadmium, chromium, copper, mercury, lead and tin and also of certain poisonous synthetic dyestuffs, though the use of many harmless ones is permitted. This survey, however, is concerned only with the retention of natural colour, in order that the consumer may obtain, from the tin or bottle, food which is identical in appearance with that which is obtained fresh.

Preserving Plant

Food is almost always processed in plant constructed of one or other of the following materials: stainless steel, aluminium, nickel, Monel metal, silver, glass and vitreous enamel. These materials are either completely unaffected by foodstuffs, or the amount of contamination is negligible, so that no colour is conferred on the food by their use. It is obvious that where food acids are involved the metal used must not be appreciably soluble or give coloured salts. Thanks to the enterprise of the manufacturers of food equipment, contamination during processing now hardly arises, but the effect of using unsuitable metals is emphasised when it is remembered that most iron salts are coloured, and copper gives blue or green salts. Nickel gives many coloured salts, but it has a very high resistance to corrosion by food acids. Aluminium, in addition to being very resistant, gives colourless salts.

Colour Changes during Storage

This aspect is of great importance. The principal means of storing foods are containers of tinplate, glass, earthenware and waxed (or otherwise prepared) paper, or a combination of these. During storage, colour changes may be due to (1) natural metabolic processes, (2) interaction between the foodstuff and the material of the container, (3) the action of sunlight, which usually results in fading. The first type of change is analogous to the destruction of chlorophyll after the death of the leaf, and its prevention is a matter of correct processing technique. Thus meats and some other products may undergo decomposition with the formation of free volatile sulphur compounds, which can attack a metal container with the production of dark-coloured stains—*e.g.*, of iron sulphide. Similarly, food acids may bring about interaction with the container with the development of unwanted colour either on the container itself or on the food; on the other hand, the colour of the food may fade. Interaction of this kind is prevented by coating the inside of the metal package with a resistant lacquer or enamel. In some cases lacquers pigmented with zinc oxide may be used, the function of the pigment being to absorb any sulphuretted hydrogen formed with the formation of colourless zinc sulphide.

Colorimetry

The object of colour comparison and measurement is twofold: (1) to maintain a constant standard of colour from batch to batch, (2) to provide a means of describing and defining colour for purposes of record. There is, underlying most of the methods in use, the trichromatic theory of colour, which postulates that any colour can be synthesised from three primary colours. Thus a particular colour may be regarded as being composed of a mixture of three primaries, such as red, green and blue, in certain proportions; for instance, the colour of the tomato, as measured on the Guild colorimeter, might be represented by the expression:

$$0{\cdot}80\ R + 0{\cdot}17\ G + 0{\cdot}03\ B.$$

The standard red is taken as monochromatic light of the wavelength 0·700μ, blue 0·436μ and green 0·546μ. It will be noticed that the sum of the three quantities in the above expression is unity. Various types of colorimeters are available for determining these data, these differing in principle and mode of operation, accuracy, ease of manipulation and cost. The chief methods are: (1) the "subtractive" method of analysis, in which the sample under test is compared with a coloured field obtained by subtracting all but the requisite mixture of primaries by means of light filters; (2) the "additive" method, in which the three primaries are mixed in suitable proportions and compared with the sample; and (3) spectrographic methods.

The Guild instrument was one of the first in general use, for the details of which the reader is referred to the original paper.[1]

Subtraction Method

An instrument which provides a rapid and comparatively accurate method of colour analysis and is relatively inexpensive is the Lovibond tintometer. It works on the subtractive principle above mentioned, and consists of a series of variable colour filters, a vertical eyepiece and a light-source operated off the usual mains, provided with special filters to give an approximation to daylight. The ray of light so produced is reflected from a

pure white screen of magnesium carbonate and passed through a series of filters of the primaries red, blue and yellow, which are so manipulated by the operator as to produce in the divided field of the eyepiece an image of similar colour to that produced by the sample itself. For very bright colours a special dark slide is used, which dulls the colour down, and the colour filters are numbered according to their relative strengths, enabling the final colour to be read off in terms of the three primaries—red, blue and yellow. Among its more general applications may be mentioned a few special uses, including the estimation of carotene in dairy produce and the antimony trichloride test for vitamin A, and by means of special modifications is used in the brewing industry, for wines and spirits, the manufacture of caramel, sugar, vegetable oils and fats, etc.

The Additive Method

An example of a colorimeter operating on the additive principle is the Donaldson instrument.[2] The primary colours used in the filters are calibrated in terms of the international units defined by the *Commission Internationale de l'Eclairage* (known as the C.I.E.), so that the readings have an absolute value. The optical layout is briefly as follows: light from a standard lamp passes through the colour filters and a condensing lens into a hollow sphere, the inside surface of which is coated with magnesium oxide, which provides a white diffusing surface; in this sphere the three primary beams are mixed perfectly and emerge as a homogeneous coloured beam which illuminates half the field of the eyepiece, the other half being illuminated by light reflected from the sample under examination. By manipulation of the shutters of the filters the first half of the field is matched to the second. The results, expressed in terms of the three primary colurs, are reproducible on any other colorimeter operating on the trichromatic principle.

A slightly simplified form of this instrument, in which the three primary colours are mounted as coloured sectors of a circular disc which may be rotated about its centre and also about an external point, enabling any desired proportion of the three colours to be passed into the diffusion chamber, has been introduced by Adam Hilger, Ltd.

The Photo-Electric Cell

The colorimeters so far described have the common disadvantage of being dependent on the human factor. Acuteness of colour perception varies considerably from one individual to another; indeed, the same observer may vary in his own colour sensitivity. Thus the eye rapidly shows fatigue after observing a very bright colour, such as scarlet or vivid green, and may need a rest before being called upon to observe something different; it also reacts markedly to bodily fatigue and is much less accurate at the end of the day than at the beginning. As regards the variation between different observers, it is obvious that between the two extreme limits of 100 per cent. colour perception and colour blindness numerous shades of sensitivity must exist. The necessity of eliminating the human eye as the ultimate detector is at once apparent, and the answer to the problem is the photo-electric cell.

Such instruments, strictly speaking, are not colorimeters, though they are often so termed, as they do not compare actual colour, but light absorption, and the name " absorptiometer " is therefore more appropriate. A brief reference to the theory behind them may be of use. When the light emitted by or reflected from a body is analysed spectrographically, a characteristic spectrum is obtained, in the case of white light the familiar sequence of colours from red, through orange, yellow, green and blue to violet being observed, the colours merging gradually into one another. If the light from a coloured surface be examined—for example, a green—the intensities of the various " lines " will be different from those in the spectrum of white light, especially in the red area, as a green surface absorbs red light strongly, and consequently light it reflects is deficient in red rays. In the same way reflected light from an orange surface will be poor in blue rays.

Absorptiometers

Absorptiometers analyse the light reflected from opaque surfaces or transmitted through transparent liquids, and by the use of colour filters select a colour of a particular wave-length and compare its intensity with that of the same colour obtained from the standard. The operator, therefore, does not see the actual colour he is measuring, but plots a curve from his readings and compares them with standards. Unfortunately, these instruments are relatively costly, but they give results of the highest accuracy.

Another instrument is the Bolton-Williams photo-electric colorimeter. Light from a standard source, controlled in intensity by means of a shutter, is passed through a 1 per cent. copper sulphate solution to filter the infra-red rays present (as these affect the photo-electric cell) into a cooling tank and all but certain selected wave-lengths cut off by passing through suitable Wratten filters. The standard liquid, as a column of definite length, is then interposed and the galvanometer, which is actuated by the photo-electric cell, adjusted to zero by manipulation of the shutter. On replacing the standard by the liquid to be examined, the galvanometer at once registers the percentage absorbed of the light of whichever colour is being used. The operation may be repeated, if required, with light of other wave-lengths. In a modified form of the instrument, opaque surfaces may be examined, so that, between the two, pastes, powders and liquids may be tested.

In the G.E.C. instrument two similar glass cells containing the liquid under test and the standard are placed on either side of the source of illumination. The light passes through the liquids into matched selenium photo-electric rectifiers which are placed on the sides of the liquid cells away from the light-source. The photo-cells actuate a microammeter, which gives readings in terms of absorption and extinction values. The instrument is operated by an accumulator.

The Spekker photo-electric absorptiometer is another instrument used for colorimetric analysis, determination of pH values, etc. It is actuated by the mains supply and so constructed as to be compensated against fluctuations of voltage. The beam of light from a 100-watt projector lamp is passed by means of a lens system through the specimen under test, and an image of the filament is produced on the photo-cell. A calibrated variable aperture mounted in front of the lens system enables the intensity of the light falling on the cell to be varied by known amounts. Since there is an image of the filaments on the cell, there is no change in the cell area illuminated when the aperture alters. The scale associated with the aperture is so calibrated that if R is the reading corresponding to a degree of opening such that the amount of light transmitted is 1/a of that admitted when the operture is fully open, then $R = \text{Log } a$. Light from the lamp also falls on another photo-cell situated on the other side of the lamp, the amount of light falling on which can be controlled by means of an Iris diaphragm. The two photo-cells are connected in opposition across a galvanometer, so that when the photo-electric currents given by the cells are equal, the galvanometer shows zero deflection.

This short survey by no means exhausts the selection of instruments available for the study of colour. Colour control and standardisation in any particular laboratory is, however, a very specific problem, for which one particular instrument will be found to be the most suitable.

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[1] Guild, *Trans. Opt. Soc.*, 1925-26, xxvii, No. 2.
[2] Donaldson, *Proc. Phys. Soc.*, 1935, **47**, 1068.

Flavouring Essences and Emulsion Flavours

(*Continued from page 128*)

little danger of separation occurring if saturated solutions are exposed, on storage, to low temperatures.

These solubilities are substantially the same as the solubilities of vanillin and coumarin in 20 per cent. aqueous glycerine solutions; but when simple aqueous solutions of glycerine are used, unless the glycerine content is increased to about 50 per cent., spoilage due to mould growth may occur. Hence the addition of corn syrup effects a saving of about 50 per cent. in glycerine. The solubility of vanillin in the mixed solvent is comparable with its solubility in 10 per cent. alcohol; but on the basis of prices ruling in the United States there is a substantial saving in using the mixed solvent, allowance being made for the tax on alcohol.

The author concludes his paper by suggesting the following formula for a satisfactory artificial vanilla flavour:

Corn syrup (43° Bé.)	6 lb. 1 oz.
Water	1 lb. 5 oz.
Glycerine (U.S.P. 95 per cent.) ...	2 lb. 10 oz.
Vanillin	1·2 oz.
Coumarin	0·9 oz.
Caramel colouring	quant. suff.

THE COMPARISON OF ODOURS

H. D. RENNER

THE COMPARISON of odours is usually practised in the same way as it has been from remote ages—by sniffing at them or eating or drinking the materials in which they are contained. There have been attempts at classification, but no measurement comparable, for instance, to the wave-lengths relating to sounds has been achieved, or indeed can be achieved. It is possible to describe somewhat poorly the psychological effects of flavours and to give them some kind of name, comparing them with natural or chemical products.

The Apparatus Described

An apparatus has been devised which can be used for comparing intensities of odours. This apparatus was originally devised as a possible means of testing the olfactory powers of human beings, and not for comparing the odours themselves. However, it might well be used in connection with the examination of different odoriferous materials with a view to the rapid comparison of their strength.

The principal element of the apparatus consists of a gas washing bottle, similar to that used for chemical purposes, but made of brown glass in order to avoid the influence of light on the contents. The separate materials are placed in bottles, and these, with an extra one which serves as a control, are arranged on a revolving table, in two circular rows, as shown in Fig. 1.

The centre of the table is pierced by two brass tubes, each of them ending in one of two circular tubes, situated in the middle of the table and above the rows of bottles. Every bottle is connected to one of the circular tubes, fitted with the shortest possible lengths of rubber tubing, and there is a valve in the connection. One end of the tubes fitted in the bottles reaches inside the table, the other end points outside and is fitted with a glass tube, also provided with a valve. This second end has to reach so far that it nearly touches a wooden screen, put in front of the table. Behind the screen the observer is seated. The tubes, leading through the centre of the table, are connected to a bellows. By setting this in action, air, under a certain amount of pressure, moves through the central tubes, enters the circular tubes, and from there to that bottle whose valve has been opened. Forced through the bottle, the air acquires the odour which it is intended to test. Before the air is blown in, the appropriate bottle has been placed, by revolving the table, opposite to a hole in the screen, so that the odour reaches the nose of the observer. For controlling the air pressure a bottle of 8 gal. capacity is inserted immediately after the bellows.

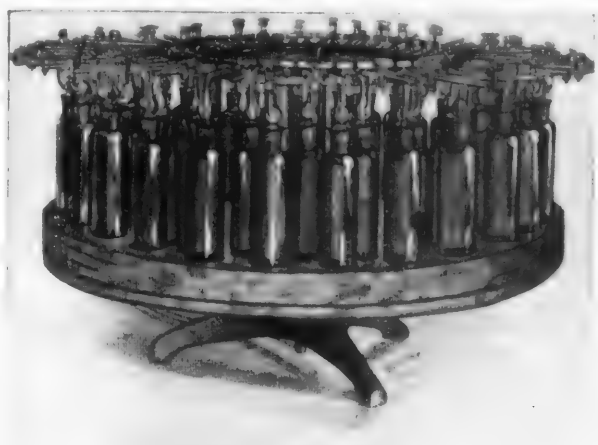

Fig. 1.

How Tests are Made

The tests require the simultaneous attention of two persons, an "experimenter" and an "observer". The experimenter chooses the bottle which has to be tested and revolves the table, so that the bottle comes on the right spot opposite the screen. He then opens the valves of the bottle. The observer has nothing else to do but to bring his nose near the hole in the screen and to press his foot on the bellows. This can be repeated if thought necessary. The observer does not need a long time for judging the content of one bottle and a long row of them can quickly be tested with this apparatus.

Professor Skramlik, who assembled the apparatus, chose forty-nine chemical compounds for his tests. Among these forty-nine materials were substances which were in some cases very similar and others very dissimilar to each other. Such a selection is indicated when the olfactory powers of a patient are being studied from a medical point of view.

Use in Food Laboratories

The number of bottles used, for instance, in a food laboratory would, of course, be dependent upon the number of materials to be examined. A possible advantage involved in the use of this apparatus in food or other factories using essences, etc., is that it can be installed in a separate room. The bottles containing the odorous materials are tightly closed and the very slight amount which escapes from them at the time of testing is not enough to impart any odour to the surrounding air, thus avoiding any vitiation of results.

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COOKING TESTS FOR GAS OVENS

THE new British Standard (B.S. 948) for Cooking Tests aims at providing a series of cooking tests which shall be—

(*a*) Sufficiently varied to reveal any defects in the cooking performance whilst keeping the number of tests to a minimum.

(*b*) Depend as little as possible on variable factors such as the skill of the operator, air temperature, quality of ingredients, etc.

After considerable investigation involving much experimental work, the following schedule has been adopted as fulfilling these conditions:

(*a*) A high-temperature test (scones).
(*b*) A heat distribution test (with trays) (small cakes).
(*c*) A heat distribution test (without trays) (sponge sandwich).
(*d*) A low-temperature long period test (rich fruit cake).
(*e*) A full load test (a complete dinner).
(*f*) A sole-heat test (optional) (plate tarts).

WHEAT GRADING IN CANADA

The gigantic machinery by which Canadian wheat is collected, graded and stored has been pronounced by experts to be the most efficient in the world, and the handling cost is decidedly the lowest per bushel, compared with similar facilities of other countries.

HENRY B. BEES

WHEAT in Western Canada is the staple commodity, by whose market price the prosperity or poverty of the bulk of the population is determined. As less than 40 per cent. of the 400-million-bushel average crop is used in Canada, it follows that the export trade is vital to the country's financial existence, and, when markets shrink under adverse world conditions, difficulties in the handling of the crop increase proportionately. Hence the war has crowded the Canadian wheat storage facilities to an abnormal extent, though, by strenuous efforts on the part of all concerned, the bumper crop of 1940 is gradually being absorbed into storage.

Bulk Handling

Since economy of space in terminal storage has always been a prime necessity to take care of the huge volume of wheat, a system of bulk handling has been evolved, so that wheat from any particular farm or district soon loses its identity and becomes a part of mass production. The gigantic machinery by which Canadian grain is collected, graded and stored has been pronounced by experts to be the most efficient in the world, and the handling cost both to the grower and consumer is decidedly the lowest per bushel, compared with similar facilities of other countries. As the spread between grades (about 4 cents per bushel) remains approximately the same each year, it follows that when the price becomes low, as at present, the more anxious is the farmer to deliver grain of a high quality, and therefore, in these times, the grain-grower is keenly interested, as never before, in the grading of his wheat.

The exporter depends also on the goodwill and satisfaction which he affords his customers, for the grain trade is highly competitive, and Canada's wheat, though excellent, has no monopoly of good qualities. The only way to ensure this goodwill is to establish a reputation for integrity, for the certificate of quality issued in the country of origin must be entirely dependable, and this fact must be well known in the wheat-buying countries. Therefore grain-handling firms and Government inspectors alike exercise strict supervision of the grading system and welcome all possible improvements.

Seven Classes of Wheat

There are seven general classes of wheat: statutory, commercial, tough, damp, rejected, smutty and sample grades. Statutory grades are defined by Parliament in the Canada Grain Act, and do not vary with each crop. Commercial grades take care of grain which because of certain climatic or other conditions cannot be included in the statutory grades. Tough wheat contains abnormal moisture not exceeding 17 per cent., while damp grain, unfit for warehousing, contains over 17 per cent. (Note.—All elevators are now equipped with moisture-testing devices, operating on scientific principles.) Rejected grades show evidence of damage, have excessive mixture of other grains, or possess foreign odours rendering wheat unsuitable for milling into flour. Sample grades contain excessive quantities of heated, fire-burnt or other foreign matter.

The " prairie sentinel ", as the grain elevator has been aptly termed, stands ready to buy, warehouse and ship the farmer's crop of wheat as soon as it is threshed and hauled, mostly in speedy motor-trucks. Prices are broadcast twice daily over the radio, so that fluctuations in the market have immediate effects. The owner of wheat may sell directly to the grain company operating the elevator or to the Canada Wheat Board, a fairly new organisation sponsored by the Canadian Government, or, if he prefers, may store the grain and sell later. If he grows much wheat he may ship in a carlot, either to Winnipeg or to the lake-head ports, and have the grading done at the other end. If he sells locally, he may take the grading of the local agent, or may wait until a sample has been mailed to Winnipeg, either of a waggon-load or a carlot, and the agent advised by mail as to the grade allowed.

Determining Grade

Government inspectors, working in a clear north light close to large windows, use great thoroughness in determining the grade of samples. The weight per bushel is first ascertained; then, after screening, the percentage of dirt and foreign matter (dockage) is calculated by weighing. Standard samples are next used to find the plumpness, quality and evenness of the kernels, degree of maturity or otherwise, damage by frost, heat, disease or any other cause, mixture of other grains, and moisture percentages, the latter by special apparatus. A certificate in the name of the owner or his agent is finally issued. The farmer, if not satisfied, has the right to call for a new inspection and, if still dissatisfied, can appeal before a special tribunal.

Constant Problems

Every new season seems to bring its own problems to the men engaged in the highly specialised business of grading wheat. In the wet years of 1927 and 1928 large quantities of tough and damp wheat had to be artificially dried and afterwards graded. Two years ago a bronzy-green colour appeared on many wheat kernels and, not being due to immaturity, presented a special difficulty in grading. The prevalence of sweet clover, or melilot, grown by many prairie farmers to replace the natural humus of the soil, on land which had started to give evidence of soil-drifting, caused, in the autumn of 1939, some ears of wheat to be rejected, as the strong flavour of the clover made the wheat unacceptable to discriminating millers. In 1940 the special problem has been split wheat.

Split Wheat

Due in some measure to the increased use of combines, which thresh the wheat at the same time as it is cut, the split wheat appeared mostly in " combine " districts of Southern Saskatchewan and Alberta. End-play of the threshing cylinders and concave teeth, due to the jolting of the machinery when travelling over uneven ground, is blamed as the principal reason. Obviously the split wheat is damaged wheat. Its principal drawback is that in repeated handling the fragments have a tendency to split again into finer pieces. Finally, almost all wheat when milled to-day in North America is " tempered "—that is, clean water is added to raise its moisture content—chiefly because in this way the bran is kept out and the colour of the flour thus improved. Hence, as the split wheat absorbs water much faster than whole wheat does, the entire split wheat is lost in the bran and shorts. If the percentage of split wheat is sufficiently high, it becomes a de-grading factor.

Fungus Diseases

During the 1940 season two fungus diseases have appeared on wheat. " Black Point ", as the name indicates, is a blackening of the germ end of the kernels, easily visible to the careful eye. This disease has been prevalent on Durum wheat in previous seasons, but it is now noticed to some extent in samples of Spring Wheat. " Kernel Smudge " is a dirty smear of a microscopic fungus, giving the rounded side of the affected kernel a dark brown appearance. Both these diseases naturally lower the grades.

The Canadian system of grading wheat, while admittedly not perfect, is giving complete satisfaction to most western farmers. Since better quality invariably brings better returns, it stimulates good farming. Again, it renders possible an economical working of the terminal storage system, of which Canadians should be proud, for it is unparalleled elsewhere. By paying cash to the farmer months before the grain is exported, it provides a basis for financing the crop. Finally, it provides the buyer of wheat with a standard article on which he can depend, much resembling the trade-marked products of reputable manufacturers.

THE ROUTINE EXAMINATION OF MILK SUPPLIES

While those concerned with the sale of liquid milk are interested mainly in the aspects of public health and bacteriological control, the food manufacturer has to take into consideration also the chemical, physical and physiological properties of the milk he purchases. In this article are discussed simple routine tests used in commercial practice.

JOHN G. DAVIS, D.Sc., Ph.D.

IN THIS country some 1,000,000,000 gallons of milk are produced annually and sold to creameries, food manufacturers and the public. The constantly varying and perishable nature of milk makes its examination in the commercial laboratory a matter of considerable importance. Probably no other product is so intricate and uncertain in its properties and behaviour as milk. While those concerned with the sale of liquid milk to the public are interested mainly in the public health and keeping quality aspects (*i.e.*, bacteriological control), the food manufacturer has to take into consideration also the chemical, physical and physiological properties of the milk he purchases. Table 1 summarises these properties and the tests discussed in this article. Only the simple routine methods are considered, as the more accurate and time-consuming tests (mentioned in brackets in the table) are not worth doing commercially except for special reasons. The usual routine tests may be divided into two classes—(1) those for the routine grading of supplies, and (2) those for picking out the "dud" milks on the receiving platform. The latter must be instantaneous or at least very rapid. For routine grading it is better to apply a simple test which is reasonably accurate a number of times than to make one or two very accurate determinations, because of the inherent variability of milk. These accurate tests, notably the Röse-Gottlieb method for fat, the gravimetric method for solids-not-fat and the freezing point test for added water, are only used when the simpler tests have pointed to gross deficiencies and legal action or warning is contemplated.

Although considered under various headings, the main chemical and bacteriological properties are interrelated, as shown in the diagram on the next page.

It will be observed that mastitis can affect all five major aspects of milk—yield, fat, solids-not-fat, flavour and keeping quality.

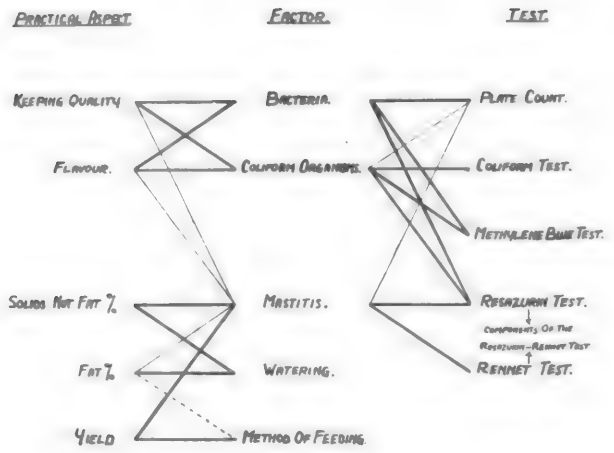
Subjective Tests

(1) **Cream Line.**—This is probably the oldest and, in the popular view, the most important test used for milk. Many housewives will judge the quality of their supply on this alone and ignore the keeping quality aspects. When souring or other taints occur it is taken as a matter of course, as though milk cannot be prevented from "going off" occasionally. There is no reason, of course, why milk of good-keeping quality cannot be sold to the public all the year round. The writer remembers that on a river camping trip one year, Institute milk *unpasteurised* kept for nearly three days in the locker of a punt in very hot weather. All milk delivered to the public should keep for at least 36 hours provided it is not held in a warm place (over 65° F.).

The cream line is, of course, not a reliable guide to the "richness" or fat content. Temperature and the size of the fat globule appreciably affect the cream line for a given fat

TABLE 1

PROPERTY.	TEST.	FACTORS CONTROLLING.
Subjective.		
"Richness" (popular)	Cream line.	Fat content, globule size (breed of cow).
Colour	—	Carotene content—breed of cow.
Smell / Taste } Flavour	—	Bacterial content; nature of feeds; mastitis.
Sediment (visible dirt)	Pad sediment test.	Carelessness in milking; absence of filtering on the farm.
Physical.		
Sourness	*p*H determination.	Bacterial fermentation; mastitis.
Clotting with rennet	Rennet test.	*p*H and protein constitution (mastitis).
Chemical.		
Acidity (alkali neutralising capacity)	Titratable acidity.	Solids-not-fat content; initial *p*H; mastitis; developed lactic acid.
Fat	Gerber and Babcock (Röse-Gottlieb).	Breed of cow; morning or evening milking; absence of skimming on the farm; absence of watering.
Solids-not-fat	Calculation from density.	Absence of mastitis; breed of cow; absence of watering.
Total solids	Drying at 100° C.	—
Added water	Freezing point.	—
Protein constitution	(i) Gold sol. (ii) Casein number.	Mastitis.
Total protein	Formol titration.	—
Bacteriological.		
Bacterial content	(i) Plate count. (ii) Direct microscopic count. (iii) Methylene blue. (iv) Resazurin. (v) Presumptive coli.	Carelessness in milking and handling; mastitis; warm weather.
Physiological.		
Cell content	(i) Direct count. (ii) Catalase. (iii) Centrifuge deposit. (iv) Resazurin.	Mastitis; stage of lactation; mechanical injury to udder.



content; low temperatures, although slowing up the rising of the fat globules, result in a deeper cream layer, and the milk from the Channel Island breeds containing large globules exhibits a deeper cream line than that from other breeds, such as Shorthorn and Ayrshire. The rich colour of the Jersey and Guernsey milk also enhances the cream line effect.

Colour

While admitting that the yellow creamy colour of Channel Island milk is pleasing and has a definite commercial value, it must not be forgotten that a rich colour does not necessarily mean that the fat soluble vitamin content is greater than in a paler milk. A deficiency in carotene may be compensated by a higher vitamin A content, the vitamin itself being colourless.[1]

Smell

This is the standard test applied at creameries and factories. The nose can often detect taints when all other tests fail. It is therefore a very delicate test, especially when the lid is first taken off the churn. A few comments on this point may be of interest.

(1) When churns arrive at the receiving platform the lids are removed and the worker's nose inserted into the churn or, in some cases, the churn lid is smelled. It follows, therefore, that not only the milk but the churn *and lid* are included in the test. The producer cannot be blamed entirely if the churn or lid is at fault, as most creameries *claim* to clean and sterilise their churns and tell their producers that this is done. It must be admitted that there are places where this treatment is not carried out properly for various reasons (*e.g.*, too weak a detergent, running the washing machine before the temperature of the detergent is up, etc.), and it should be made an offence for any purchaser to return improperly washed and sterilised churns to producers.

(2) In summer a tainted milk probably means a dirty milk, but in winter, when bacterial growth is slow, other taints such as those due to feeds, enzymes, catalysts, etc., may form an appreciable proportion of the total. It is unjust to condemn such milks as dirty for two reasons, (1) the taint is not due to faulty methods of production in the ordinary sense and (2) the milk, although perhaps having an unpleasant smell in the churn, will not usually affect adversely the keeping quality of the rest of the milk, and the odour will in all probability pass off on standing or aeration.

Taste

Milks are usually not tasted in routine testing. Nevertheless certain taints, such as bitterness, will escape detection by smell alone. In keeping quality tests milks should be first smelled at a temperature of 35° to 40° C., and then heated to 72° to 75° C. to destroy any undesirable organisms before tasting. Boiling, however, produces a cooked flavour which may mask others.

Sediment

Visible dirt in milk may be classified as (i) sand, gravel, etc.; (ii) soil; (iii) dung; (iv) hair, etc.; (v) pus, etc. Of these (i) is of little consequence, but (ii), (iii), (iv) and (v) are very undesirable. It may be mentioned, however, that the effect of dung on milk is less than that attributed by popular sentiment. Its effect is far less, for example, than that of milk residues in dirty utensils. In fact, although the presence of coliform organisms is commonly attributed to fæcal contamination by some people who are given to making weighty pronouncements about milk without ever investigating it at first hand, dirty utensils are, in practice, the most important source of these bacteria and the most frequent cause of poor keeping quality. Coliform organisms proliferate rapidly in milk and milk wastes, especially in warm weather, and are the commonest cause of poor keeping quality.

There is little correlation between sediment and keeping quality or any of the bacteriological tests, at any rate in winter. Producers are, of course, supposed to filter their milk on the farm, but many do not, and some of those who do filter are, in fact, contaminating the milk by using unsterile filter cloths. Pus and cell debris are æsthetically undesirable and abnormal amounts indicate mastitis. Sometimes churned fat may stick on the sediment pad and simulate pus, but this is readily detected on drying the pad.

Physical

Sourness.—The commonest fault in milk, at any rate in summer, is souring, due to the growth of lactic streptococci, coli-aerogenes bacteria and, to a lesser degree, other lactose-fermenting organisms such as staphylococci. Fresh normal bulk milk has, initially a *p*H of 6·5 to 6·65, a higher *p*H indicating mastitis and a lower one souring. Milk begins to clot at pasteurisation temperatures (145° to 160° F. or 63° to 70° C.), when the *p*H is about 5·9 and the titratable acidity about 0·32 per cent., although deposits are formed at much lower acidities, so that the practical limit for pasteurisation is about 0·22 per cent. When boiled, milk will clot at about *p*H 6·2, titratable acidity about 0·25 per cent. At room temperature (18° C.) milk clots at *p*H about 5·1, titratable acidity about 0·5 per cent. The *p*H and not the titratable acidity is the real criterion of the degree of souring and whether milk will pasteurise without clotting. Two groups of tests are available for testing the *p*H of milk—accurate electrometric methods and approximate indicator methods.

Electrometric Methods

The glass electrode is, of course, the best method, but its expense prevents its general adoption. Care should be taken when testing milks to clean the electrode thoroughly between tests, as otherwise adsorbed films of protein and fat may lead to serious errors. The electrode should be cleaned in *dilute* acid or alkali. Greasy films may be removed by carbon tetrachloride; solvents such as acetone should be avoided, as these dehydrate the glass surface and lead to unstable potentials.

The quinhydrone is a simple and convenient method under normal conditions, although large numbers of sulphide-producing bacteria may lead to poisoning of the electrode. If a potentiometer is available the apparatus is not expensive, and a very simple outfit is satisfactory for routine work.[2, 3] It is convenient to use $\frac{M}{20}$ phthalate buffer[4] for the standard half-cell instead of the usual hydrochloric acid-potassium chloride "buffer", and to use a standard phosphate buffer at *p*H 6·81[4] for checking the electrode. With care the error does not exceed $\pm 0{\cdot}02$ *p*H units—the error of the standardising buffer.

Indicator Methods

The turbidity of milk prevents the direct determination of the *p*H in a comparator. Sharp and McInerney have described a dilution method to overcome this difficulty,[5] and Davis and Thiel[6] have suggested that bromthymol blue is preferable to phenol red for routine work, as, although it behaves abnormally, better matching is obtained. The average error is about 0·05 and only occasionally greater than 0·15.

Various indicator-impregnated cellophane slips are available on the market, but as their error is at least $\pm 0{\cdot}1$ they are hardly worth the time involved in use and expense in purchase.[7, 8]

A well-established test is the alcohol-alizarin test, in which both the colour of the indicator and the degree of precipitation of the protein serve to indicate the lowering of *p*H.[9] The variable fat content and pigment of milk seriously influence the indicator part of the test. To make the test at all accurate, therefore, it is essential to have separate standards for Channel Island milks.

Clotting with Rennet

The rennet test is the simplest test for the normality of milk.[10] Clotting is accelerated by low *p*H values (*i.e.*, souring) and the presence of milk from freshly calved cows. It is retarded by high *p*H values, low casein and calcium, and abnormal protein constitution. All three conditions are caused by mastitis, and in practice it may be assumed that milks clotting slowly with rennet are from infected cows.

The rennet test is conveniently combined with the resazurin test,[11] as these two tests work independently of each other. It is important to standardise the age of the milk in the rennet test, *e.g.*, single cow samples at 3 hours after milking and bulk milks (evening and morning mixed) at about midday.

Chemical

Titratable Acidity.—When only one " scientific test " is made on milks in creameries and factories, this is the one usually done. There is a tacit assumption that fresh milk has an acidity of *c.* 0·15 per cent. lactic acid, and that if the acidity exceeds this, it is due to souring. The usual plan is to reject milk if it has a taint by smell and the acidity is over a certain limit, usually 0·2 per cent. in summer and often less in winter, *e.g.*, 0·17 per cent. The writer has known a limit of 0·15 per cent. set in winter. It is unfortunate that the nature of the acidity of milk is quite unrealised by most of those making the test, both in the dairy and other industries. As used in practice, the test may lead to gross injustice to the producer, especially in winter. Generally speaking, it may be said that titratable acidity (T.A.) measures not only souring but also the protein and phosphate in the milk.[12, 13] In fresh milk, or milk in which only a negligible degree of souring has taken place, there is no correlation between bacterial content or keeping quality and T.A. but a good correlation between solids-not-fat and T.A.! It follows, therefore, that rich milk, high in solids-not-fat, will give a high T.A., and " mastitis milk " low in solids-not-fat a low T.A. Hence it is possible for a rich milk of low bacterial content to give a high T.A., and if it has a slight odour, which may be due to feed or other quite harmless causes, it may be condemned. On the other hand, " mastitis milk ", being of low T.A., is regarded as good milk! In summer the T.A. test is reasonably safe in the hands of the control laboratory; in winter, when souring is slight, it is not only useless but misleading. Then the writer has known of some milks which had an *initial* T.A. of 0·22 per cent. and which were returned to the producer for this reason, to his eternal perplexity. The following recommendations are therefore made:

(1) The term " titratable acidity " be discontinued and the term *total acidity* (still better, of course, would be " alkali absorbing capacity "), implying *initial acidity* (*or buffer value*) + souring *acidity*, be adopted.

(2) The T.A. test be omitted in winter, until some simple method of distinguishing souring acidity from initial acidity becomes available.

(3) Workers in the industry should collaborate to devise such a simple method. This will involve either a quick estimation of lactic acid or a simple indirect method of calculating the true initial acidity. The latter can be obtained from the solids-not-fat value, as there is a fairly close relationship between initial acidity and solids-not-fat. The estimation of S.N.F. takes time, however, and so cannot be used as a routine technique for " rejections ". Other possible methods would be (i) direct estimation of lactic acid in the milk, (ii) indirect estimation of the degree of souring by methylene blue or resazurin tests, and (iii) rapid estimation of S.N.F. by measurements of buffer value or the formol titration. The formol titration is easily and rapidly carried out, but the relationship between initial T.A. and formol titration is not close enough for this purpose. The correlation between formol titration and *S.N.F.* is, however, quite good.

Table 2 summarises the usual effect of souring, watering and mastitis on the *p*H, titratable acidity, formol titration and their ratios.

The resultant values are, of course, not rigid and will vary according to the degree of abnormality, souring and watering. They do show, however, that the factors can mask one another in these simple tests. For example, it is impossible, using only the *p*H, titratable acidity and formol titration tests, to distinguish normal, unsoured milk from soured mastitis milk! This is a good example of the inherent unsoundness of the titratable acidity test. From the point of view of effect on the keeping quality of a bulk of milk, there is a considerable difference between an unsoured normal milk and a slightly soured mastitis milk, as the latter, although indistinguishable from the former at the time of testing, will seed the bulk with a number of souring organisms.

Fat

This is the compositional aspect most commonly estimated, and there are many reasons for this. It is the only constituent which can be visibly detected (cream line), it defines the butter yield of milk[14] and very largely the cheese yield.[14, 15, 16] In England the legal limit for fat is 3 per cent. This is a generous one, but in the flush period of summer some producers have difficulty in this direction, especially in the morning milk of the low fat breeds (Friesian and to a less extent Shorthorns). The Gerber test is almost universally used in this country[17] and has an accuracy of $\pm 0{\cdot}05$ per cent. If a low value is obtained and legal action is contemplated, a gravimetric determination such as the Röse-Gottlieb or Adams should be made. It is not uncommon for creameries to pay a bonus for butter-fat when butter or cheese is made.

Solids-not-Fat

Although comparatively ignored, this is of more importance from a nutritional point of view than the fat. Whereas the latter is important in itself and also as a source of vitamin A (the amount of D is very small), the former contains first-class protein, sugar, calcium and other salts, and vitamin B, especially B_2.[18] The legal limit is 8·5 per cent., and it is probable that failure to attain this is almost always due to mastitis.[19, 20] It was formerly thought that low solids-not-fat was associated with certain herds, methods of feeding and types of land, but these explanations are now discredited.

The invariable routine method is to determine the density by a hydrometer and then to calculate the solids-not-fat from the fat and density. A more accurate form of the old Droop Richmond formula $T.S.=\frac{6}{5}F+\frac{G}{4}+0{\cdot}14$ is now available—viz., $T.S.=0{\cdot}25D+1{\cdot}21F+0{\cdot}66$.[21]

The accuracy is probably about $\pm 0{\cdot}2$ per cent.

The value of solids-not-fat figures for the buyer is twofold—(1) it helps him to safeguard himself against possible legal action for selling milk below the legal limit, and (2) it affords a valuable clue to advisory work on mastitis.[22]

TABLE 2

	Milk.	*Souring.*	*Watering..*	p*H.*	*T.A.*	$\frac{pH.}{T.A.}$	*Formol Titration.*	$\frac{T.A.}{Formol\ Titration.}$
1	normal	o	o	N	N	N	N	N
2	,,	+	o	low	high	low	N	high
3	,,	o	+	N	low	high	low	N
4	,,	+	+	low	N	low	low	high
5	abnormal	o	o	high	low	high	N	low
6	,,	+	o	N	N	N	N	N
7	,,	o	+	high	low	high	low	N
8	,,	+	+	N	N	N	low	high

N = normal.

Total Solids

This is, of course, the sum of the fat and solids-not-fat. The nutritive value and also, generally speaking, the value of milk for food manufacturing purposes and cheesemaking are dependent on the total solids in the milk. Moreover, the cost of production of milk is directly dependent on its total solids content. It is only just, therefore, that milk should be bought on a total solids basis.[15] Broadly speaking, high fat goes with high total solids, but where milk is required specifically for cream or buttermaking a special fat bonus may be paid. Milk *may* be high in fat and low in solids-not-fat, and *vice versa*. The first condition is generally due to mastitis, especially in a Channel Island herd, and the second to skimming or holding back the strippings.

A direct determination of total solids may be made by drying milk for three hours at 100° C. or by the rapid Carter-Simon oven method.[23] If the solids-not-fat value is also required the fat must be determined as well.

Added Water

There is little doubt that many samples of milk contain added water, and this fraudulent practice is not hunted down and the perpetrators punished as they should be. Payment on a total solids basis would abolish the evil as far as the producer is concerned.[16]

The best method of detecting the presence of added water is undoubtedly the freezing point. This depends on the fact that milk always maintains a practically constant osmotic pressure corresponding to a freezing point of about −0·54° C. Mastitis lowers the lactose and raises the sodium chloride content, the osmotic pressure remaining constant. Although accused producers defend themselves by assertions of illness in the cows, unusual feeding methods and the excitement of enemy action, there is no evidence that any of these can affect the freezing point. Extremely rare cases of individual cows giving milk of abnormal freezing point have been reported, but the producer is always safeguarded by the " appeal to the cow " test.

Another test depends on the fact that all naturally occurring water contains nitrate, but this has not been extensively used in this country.

A low fat *and* solids-not-fat suggests the addition of water; a low solids-not-fat and only slightly low or normal fat, mastitis.

An apparatus permitting the rapid determination of the freezing point has been described by Temple.[24]

Protein Constitution

Normal milk contains about 78 per cent. of its total nitrogen as casein, 10 to 14 per cent. as albumen, 4 to 6 per cent. as " globulin " and 5 to 6 per cent. as non-protein nitrogen. The last is fairly constant, but the ratio of casein to the water-soluble proteins is variable and appreciably affected by mastitis.[25, 26]

Aschaffenburg has applied the gold sol test to milk and shown that it can be used as a simple test for abnormal milks.[27] It thus resembles the rennet test, with the important difference that the gold sol test is independent of the *p*H of the milk, whereas the rennet test is greatly affected by the *p*H and therefore by souring. For a given abnormality in protein constitution the rennet test will be the more sensitive the higher the *p*H, the gold sol test remaining at the same sensitivity.

Total Protein

The Keldjahl method is usually employed when an accurate value is required; an approximate figure may be quickly obtained by using the formol titration method. This may be considered as a simple empirical estimation of the protein in the milk. A fairly accurate idea of the casein content may be obtained if this is first precipitated and filtered off before titrating.[28] As ordinary mastitis does not significantly affect the total protein content of milk, " mastitis milks " usually have a normal formol titration and a low T.A. The casein proportion is low, and this fact can be used as a chemical method for diagnosing mastitis[25] with, however, the usual limitation in that late lactation milk physiologically resembles mastitis milk.[26] The determination of total and casein nitrogen by the formol titration is not sufficiently accurate for this purpose, although the worst cases could be detected by this simple modification of the casein number technique.

Bacteriological Examination of Milk

There is no really accurate method for determining the bacterial content of milk and milk products. Many methods are available, some of them indirect, and each has its own characteristic limitations and advantages. Since from the industrial point of view keeping quality and flavour are the most important aspects, it is advantageous to use methods which either distinguish those types of flora particularly affecting these properties or are considerably affected by the organisms concerned.

The following methods are available for purposes of routine examination :

Direct: (1) Direct microscopic count.
(2) Plate colony count.
Indirect: (3) Methylene blue test.
(4) Resazurin test.
(5) Presumptive coliform test.

(1) Direct Microscopic Count

This method, also known as the " Breed count ", is a measure of the total (dead and living) bacteria in milk. Usually 0·01 ml. of milk is smeared over 1 sq. cm. on a slide, dried, stained with methylene blue or Newman's stain[29] and a number of fields counted under the $\frac{1}{12}$ in. objective. Bacteria which do not take the stain are naturally not counted. The method has the following advantages: (i) it is quick, (ii) the working costs are negligible, (iii) predominating types of flora can be recognised, (iv) cells and long-chained streptococci indicating mastitis can be observed. The disadvantages are—(i) initial cost of the microscope, (ii) fatigue in counting, (iii) large errors due to the small sample and the factor converting average number of cells per field to count per ml.—usually about 300,000. It is therefore unsuitable for milk of good hygienic quality. (iv) It does not differentiate between dead and living bacteria.

Usually the count by this method is about four times higher than that given by the plate count. This is due to the fact that many of the cells are dead and also that clumps, while perhaps containing many bacteria, will only produce one colony on a plate. Some workers, therefore, make bacterial clump counts.

(2) The Plate Count

This is generally considered the best method of estimating the bacterial content of milk.[20, 21, 22] It has many important advantages. Thus the appearance of the colony permits identification in many cases. Specific organisms are associated with specific faults or potential faults, so that a high count of a particular bacterium is often the clue to a particular trouble or shortcoming in the methods of production. The writer has, in fact, known commercial dairy bacteriologists who have returned to the plate count after experience with the methylene blue test for this reason. Moreover, the latter sometimes fails to detect bad cases of mastitis which are easily recognised by a plating method, especially if a differential medium is used.[33]

The method has some serious disadvantages, of which perhaps the most important is the time elapsing before a result is known (48 hours). Against this is the advantage that a *count* means something to the producer, whereas a *time* has little significance. Plates, like sediment pads, can be shown to producers, and the psychological effect of this has to be experienced to be realised. The expense involved in the purchase and cleaning of the glassware is naturally a disadvantage when one compares this with the negligible costs of the methylene blue test. The usual size of sample (1 ml.) also places this method at a disadvantage compared with the dye test, although 10 ml. can, of course, be used.

(3) The Methylene Blue Test

This test[31, 32, 34] has been in use in practically every dairy control laboratory for about five years, and it is now possible to summarise its advantages and disadvantages.

A prime factor is its smaller cost and rapidity compared with the plate count. Concerning the fundamental differences between the tests, it may be said that the M.B. test picks out actively growing cells fermenting lactose and largely ignores sluggish bacteria and those not fermenting lactose. The plate count detects both. Further, the methylene blue test does not detect mastitis (tissue cells and *Str. agalactiæ* not being efficient reducers of methylene blue [35]) and also fails to respond to weakly reducing strains of *Bact. coli*.[36] The plate count detects the first and the coli test, of course, the second.

The dye test is, moreover, more sensitive to atmospheric temperature than the plate count, an increased lag period being of greater significance in the short time of the dye test.

(4) The Resazurin Test

Resazurin is a dye which has two stages of reduction—(1) an irreversible stage not influenced by air (blue to pink), (2) a re-

versible stage (pink to white). Stage (1) is easily effected by tissue cells and micro-organisms of poor reducing powers. Stage (2) has a lower Eo than that of methylene blue, and about half an hour longer than the methylene blue reduction time is accordingly required when milks are left to effect complete reduction of the dye.

Resazurin is considerably influenced by cells, and therefore by mastitis, colostrum and to a less extent late lactation milk, but is not so accurate as methylene blue in measuring the bacterial content of milk, the latter dye being practically unaffected by cells. The advantages of resazurin may be summarised as follows: (i) quickness, the test being over in about one hour; (ii) the Lovibond comparator permits an accurate estimation of the colour; (iii) only one reading is required; (iv) air has no effect on the first (irreversible) stage of reduction; (v) it is sensitive to mastitis; (vi) it is sensitive to weakly reducing organisms; (vii) it can be combined with the rennet test; (viii) contamination in the test is of less consequence. One objection to the resazurin test was that the estimation of the colour was subject to personal errors, but a comparator is now available[37] and should be used.

It may be said quite safely that the resazurin test never condemns unfairly a milk that is low in bacteria and cells. Occasionally a milk containing a small number of powerfully reducing organisms may be detected by methylene blue but passed by resazurin.

A number of modifications of the resazurin test has been described, of which perhaps the most useful is the resazurin-rennet test.[11] This is simply a combination of the resazurin and the ordinary rennet tests, and is especially valuable for factories making cheese or processing milk, the rennet test detecting abnormal (" mastitis ") milk.

The rapid resazurin test[38] is applicable when all that is desired is the detection of the poorest milks, *e.g.*, those reducing methylene blue in less than two hours. It consists in incubating the sample with resazurin for five minutes at 45° C. Now that a comparator is available[37] it is recommended that the normal concentration of dye be used for the rapid test.

(5) Presumptive Coli Test

The value of this test is twofold—it detects those mistakes in production which " let coli in " without greatly influencing the count, and it enhances the value of the plate count to afford a more accurate valuation of the keeping quality of the milk.[39]

Sometimes a series of dilutions all give about ½ in. gas in the fermentation tubes. When this is observed the possibility of *anaerobes* should be suspected. This can be checked by re-inoculating from the tubes into fresh sterile tubes. Failure to produce gas in the second culture may be taken as evidence that the gas in the first set of tubes was due to anaerobes and not to coli. From the point of view of production methods, however, the positive " presumptive coli " result should stand.

It is recommended that bromcresol purple or bromthymol blue be used in the broth instead of neutral red as an indicator of acidity. The latter is reduced in acid solution to a yellow form resembling the alkaline form, a point of much perplexity to those unaware of this fact.[40] Thus the writer has often been questioned as to the significance of " alkalinity with gas ".

Cell Content

Direct Cell Count.—The technique for this is as for the direct bacterial count. It is sufficient to place the milks in broad groups, *e.g.*, under 100,000; 100,000 to 300,000; 300,000 to 1,000,000; 1,000,000 to 3,000,000; and over 3,000,000. These may be graded as o (good), ? (fairly good), + (moderate), + + (bad) and + + + (very bad).

Catalase Test.—This is one of the oldest and best-known tests for abnormality. It is fairly independent of conditions of testing and is, together with the solids-not-fat test, possibly the best routine test for mastitis in aged bulk milks. A very simple method has been described[34, 41] for routine purposes.

Centrifuged Deposit Test.—The amount of cell debris is measured in a Trommsdorf tube; normal milk should give less than 0·01 ml. from 10 ml. Mechanical dirt (soil, sand, etc.) should be ignored in this test.

Resazurin Test.—This applied within four hours of milking to single cow or quarter samples taken aseptically is, for all practical purposes, a measure of the cells in the milk. In aged bulk samples an early reduction of the dye to lilac, mauve or pink, followed by a long lag period before reduction to white (colourless), indicates a high cell content and therefore mastitis.

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SAVING MORE TINPLATE

An additional annual saving of from 30,000 to 40,000 tons of tinplate is expected to result from the extension of the restrictions placed on the use of uneconomic and non-essential tinplate containers under a new Order, made by the Ministry of Supply, which came into force on Monday, April 28. The Order (the Control of Tins and Cans [No. 4] Order, 1941), which cancels the three previous Orders, incorporates new Tables of the British Standards Institution Schedules relating to size and shape of containers, and prohibits the use of tinplate for packing some thirty additional commodities.

While the provisions of the Order are similar to those of previous Tins and Cans Orders, there are three important changes:

1. Responsibility for carrying out the terms of the Order is now placed upon the packer of the commodity as well as on the manufacturer of the container.
2. Partly made containers or articles which are not now permitted by the Order must be completely finished within three months after the date of the Order.
3. A packer using a permitted container must pack it with the net weight or capacity specified, or in some cases with both the net weight (or capacity) and the ullage so specified in the B.S.I. Schedules.

There will be no more tinplate containers for such commodities as liquid coffee essence, meat extract cubes (except medicated), corn plasters, chocolate laxatives, fishing bait, incense, gramophone needles and sparking plugs.

The Order is obtainable, price 2d., from H.M. Stationery Office, York House, Kingsway, W.C. 2.

VEGETABLES AND VITAMIN C

T. CROSBIE-WALSH, F.I.C.

THE road to clarity in this vitamin-in-vegetable business is " beset with Pitfall and with Gin " for the dietitian and much more so for the enquiring layman, who sometimes demands " a straight answer to a straight question ", not realising that there probably does not exist either one or the other under the sun.

Tomatoes and more Tomatoes

Most scientists express themselves with strategic caution, but quite a number of loose statements find their way into print. For instance, Dr. W. F. Bewley, writing recently in *The Fruit Grower* about tomatoes, states : " Some may say, ' Why all this fuss about tomatoes; are they so very important?' " And, in pointing out that the tomato is a very good substitute for citrus fruits, he discounts the value of leafy vegetables, on the score that little but the roughage remains after the cooking water has gone down the kitchen sink, and that there can be no argument against the cry of " Tomatoes, more tomatoes and still more tomatoes ".

Nobody will have a word to say against tomatoes (except a few unfortunate allergic people), but when it comes to comparing them unfavourably with other useful and readily available foodstuffs it is advisable to examine the matter more closely, especially as such comparison may well produce a reaction against the latter, even when tomatoes are out of season or still too expensive for the ordinary purse.

In these days when the sucking of the luscious orange, giving both gustatory satisfaction and the daily *quotum* of vitamin C, is denied us, the tendency to evaluate substitutes in both terms is predominant. But in assessing the degree of accuracy which can be obtained in such evaluation the anxious enquirer is confronted with an appalling number of variables. These are accounted for in the tables in some such way as this. Vitamin C content of tomatoes, 12·9–39 mg. per 100 gm. Obviously, according to what figure is adopted, so falls the tomato in its particular class with respect to other vegetables.

Cultural Methods affect Vitamin C

Some recent researches by Brown and Moser, of the Utah Agricultural Experiment Station, published in *Food Research*, 1941, **6**, 1, demonstrated that Stone tomatoes grown in the greenhouse showed a mean vitamin C value approximately one-half as great as that of the same variety grown in an outdoor plot near the greenhouse. Incidentally, the findings of the authors that there was no indication of vitamin C loss when tomatoes were held as long as 18 days, either at laboratory temperature or in the refrigerator at 6·7° C., are interesting, in view of the figures recently given on the loss of the vitamin during the storing of vegetables.

The differences found in the plants themselves constitute only one aspect, as was demonstrated at a recent discussion of the nutrition panel of the Society of Chemical Industry. The unstable and soluble nature of ascorbic acid was well shown by Miss Mamie Olliver in her paper on the effects of cooking upon vegetables. A green vegetable bought in the shop may possibly contain only 60 per cent. of the vitamin C contained in it when harvested; another 20 per cent. is lost when preparing the vegetable for the table; 65 per cent. of what remains is extracted in the liquors. Thus 17 per cent. is all that is left when the vegetable reaches the table, and if it doesn't get there quickly from the pot it may lose most of this.

While Miss Olliver was speaking one could almost see the phantom of Mrs. Beeton wringing her hands, for one of her (Mrs. B.'s) star recipes for cooking cabbage was to boil it in three separate lots of water for ten minutes each, throwing away the water after each operation.

Value of Leafy Vegetables

In face of the figures given, it would almost appear that Dr. Bewley's tomatoes were impregnably established. But at the same meeting Dr. Magnus Pyke exhibited a table which demonstrated the superiority of certain leafy-green *cooked* vegetables, especially broccoli tops, over all other vegetables raw and cooked. This despite the losses incurred in cooking and the rejection of the cooking liquors.

The Ministry of Food has followed up the matter by publishing in their " Food Facts No. 41 " a list of some vegetables, together with their vitamin C content in international units. Ignoring losses in weight of substance during cooking, the vitamin C loss in cooking of cabbage is shown to be 62·5 per cent., which is a moderate estimate. While there can be no doubt but that the education of the general public in scientific matters connected with food is a worthy object, it is probable that " Food Facts No. 41 " will not drive home the facts of vitamin C to the person concerned—*i.e.*, the housewife—in a sufficiently clear manner. It was tried recently on some representative ones, and as soon as they got as far as " international units " their interest faded. Apart from this, surely the possibility of salvaging a large part of the vitamin in the cooking liquors and some warnings against overcooking and " keeping hot " might have been stressed?

Canned Vegetables

The periods during which vegetables are scarce or unobtainable must be considered. This leads to the consideration of the canned variety.

The losses of vitamins during canning was discussed by Mr. W. B. Adam at the meeting of the nutrition panel. The vegetable canner's product has the advantage over the domestic variety purchased at a shop in that his raw material is harvested and treated at once, thus avoiding the very serious loss incurred during storage, although amounts of recently picked vegetables available from allotments discount this advantage to some extent. During the operation of blanching, which is carried out to clean the vegetables, to destroy their enzymes, to free them from dissolved gases, to cause shrinkage and ensure closer packing and, finally, to improve the colour of the product, a loss of from 30 to 70 per cent. of vitamin C was said to be incurred. From 20 to 40 per cent. of the rest goes into the liquors.

It would need a great deal more data to be enabled to judge to what extent canned vegetables of different kinds compare with those domestically cooked, but the probability is that there is not much difference in their vitamin C content.

In attempting to draw out a reasonable scheme for vitamin C intake in times when fruits are scarce, what are we going to do about all these variations due to different varieties, storage and cooking?

It is obvious that it is only possible to adopt approximate values, and it would be advisable to err generously on the side of under-estimation rather than over-estimation of the vitamin C content when quantities of vegetables to be consumed are recommended. There is no evidence at present that harmful effects accrue from over-dosage, and in these days there is very little likelihood that this could occur.

Stress might be laid upon the use of raw vegetables—even those which are ordinarily cooked, but to induce people to eat them is probably as hard a task as to induce them not to pour vegetable cooking liquors down the sink.

It would be useful if, when new tables of vitamin content of vegetables are being compiled, there be indicated precisely what part of the vegetable was used and whether the analyses were made on the fresh or stored produce. The fact that 2 ozs. of fresh vegetables are worth, in terms of vitamin C, 4 ozs. of those bought in a shop seems important.

At village concerts years ago a favourite recitation used to be " The Bishop and the Caterpillar ", which described the dilemma of a worthy ecclesiastic who had been asked by a child : " How many legs has a caterpillar got?" To save his face the bishop sent the beedle round the town to ask, but he came back with the reply : " Nobody knows!" Something of the kind happened about broccoli at the meeting of the nutrition panel.

In happier times, not too far distant, we shall be able to return to our grapefruit and orange juice, but the knowledge gained and interest taken in humble " greens " will not be lost. This interest has not been confined to their vitamin C content, and more and more light is being thrown upon the other vitamins and metal and protein content.

Finally, the manner in which to take fullest advantage of as much of vitamin C as possible by the prudent cooking of vegetables and by the consumption of the cooking liquors should be widely disseminated through the Press, the wireless and the general practitioner of medicine.

LETTERS TO THE EDITOR

EXPRESSION OF COLORIMETER RESULTS

TO THE EDITOR OF FOOD MANUFACTURE

DEAR SIR,—There has for some time been a demand for the expression of the results given by the colorimeter in terms of red and yellow units—in the case of yellow, brown, orange and red colours—as many of the users are more accustomed to thinking in these terms than in trichromatic units.

With this in mind, I have spent a considerable amount of time in seeing whether such a method of expression would be possible, with the result that I have now evolved a method which is giving very satisfactory data.

It must be admitted that the method is open to some criticism on theoretical grounds, since it is not universally applicable; but the characteristics of so many of the natural colours of, *e.g.*, oils and fats and organic solutions (such as tanning extracts), are such that the strictures do not apply to them.

The method was developed, in the first instance, partly in order to obtain a check of Lovibond Tintometer readings and to eliminate certain discrepancies that occurred between the readings of different individuals with that instrument—not as a result of any fault in the tintometer, which is an excellently designed tool, but from idiosyncrasies in the observers. In this it may be said to have succeeded very well.

The method is based on the premise that the colour of a solution may be defined by the percentage of red, green and blue light it transmits or absorbs. If this is measured in the Bolton and Williams Colorimeter, and if similar values are known for each combination of the red and yellow units in terms of which the colour is required to be expressed, then it is obvious that the conversion can be made. To simplify it I have prepared a table giving the red equivalents of the various Bolton and Williams absorption percentages, and this is now in use. Similar tables are in preparation for obtaining yellow figures and for "neutral" figures representing the difference in lightness between the red-yellow combination and the sample. These will be available shortly.

A note of the early work done in connection with this method appears in a report of a committee of the International Society of Leather Trades Chemists, abstracted in *Analyst*, 1940, **65**, 568.

Yours faithfully,
K. A. WILLIAMS, B.Sc., F.I.C.

WHITE v. BROWN BREAD

TO THE EDITOR OF FOOD MANUFACTURE

DEAR SIR,—I have read with interest your Editorial in the May issue, entitled "White *v.* Brown Bread", and, while I do not propose to enter into this threadbare controversy, there are one or two points in the article which you quote written by my friend A. L. Bacharach, whose views I always regard with very great respect, that are not quite so simple as is made out.

It is stated that "if wheat has to be stored it should be stored for as long as possible in the form of whole grain, and for as short a time as flour". There are a number of objections to this:

(1) Storage as whole grain is wasteful of storage space, flour could be stored in about half the space as the wheat from which it was milled, and the problem of storage space is very acute just now.

(2) Storage as wheat means that it will have to be kept in the vicinity of the mills rather than on the premises of the bakers spread all over the country, which is the logical place for it to be kept.

(3) If stored as flour, it is a stage nearer the consumer and can be used as food at once, even if a large amount of milling capacity is put out of action, and would tide over the period of reconstruction or, at any rate, part of it.

(4) Certain types of wheat, particularly English, are so damp that they will not keep long. They soon get musty and become unfit for use unless a costly pre-drying process is used, or unless valuable silo space is wasted in order to have the wheat continually turned over.

I have found that properly milled flour (free from germ) will keep perfectly fresh in hessian sacks in a well-constructed concrete warehouse for over two years, and that is much longer than one would like to store English wheat.

With regard to the disposal of the germ, Mr. Bacharach hints at "the commercial interests of the milling industry" being vitally concerned in maintaining the trade in offals, but one fancies that there are other interests than those of the millers vitally concerned in the marketing of wheat germ, which is purchased from the millers at £17 10s. a ton and retailed in the form of fancy goods for invalids and babies at prices very much higher than this. As to middlings and bran, the miller does not get any more for these as cattle food than he would if they were sold as wholemeal, so the argument does not arise in this case.

With regard to these so-called commercial interests, let us consider the facts and leave the "hot air" for wheat drying. An essay into elementary mathematics will show that a miller would be better off financially if he sold all his wheat as 100 per cent. wholemeal than as 75 per cent. flour and 25 per cent. offals.

On the basis of 100 cwts. mill production:

		£ s. d.
(1) 75 cwts. flour	= 30 sacks @ 25s. 6d.	= 38 5 0
24 cwts. offals	@ 8s. 0d.	= 9 12 0
1 cwt. germ	@ 17s. 6d.	= 0 17 6
		£48 14 6

		£ s. d.
(2) 85 cwts. flour	= 34 sacks @ 25s. 6d.	= 43 7 0
14½ cwts offals	@ 8s. 0d.	= 5 16 0
½ cwt. germ	@ 17s. 6d.	= 0 8 9
		£49 11 9

		£ s. d.
(3) 100 cwts. wholemeal	= 40 sacks @ 25s. 6d.	= 51 0 0

On the basis of 100 cwts. production he would actually receive £2 5s. 6d. more if he sold his wheat as 100 per cent. wholemeal than as 75 per cent. white flour and 25 per cent. offal, and £1 8s. 3d. more if he produced the 85 per cent. wheatmeal flour instead of 75 per cent. white flour. These facts speak for themselves.

Yours faithfully,
T. H. FAIRBROTHER,
Director and Chief Chemist, McDougalls, Ltd.

FOOD FOR BRITAIN FUND

TO THE EDITOR OF FOOD MANUFACTURE

DEAR SIR,—Many well-meaning Americans have contributed to "Food for Britain Fund", and I was wondering how this was being worked. I have been recently enlightened up to a point, as one of my neighbours—an American lady—received a cable to say that a parcel of food would soon be reaching her from the Food for Britain office in New York. After some weeks the parcel turned up. It was packed by the London firm of Johnston, Hewson and Co., Ltd.

The parcel contained tins and packets of Lancashire hot-pot, stewed steak, French sardines, salmon, carrots, pears, two boxes of sweets, nine tablets of soap, slab cake, gelatine of ham and chicken, coffee, cocoa, macedoine of vegetables. Every packet and every tin except the sardines were British products.

The lady in question is not poor and would certainly resent the description, and I am left wondering who is benefiting from the scheme. I have the feeling that there may be some misplaced effort and expenditure somewhere.

Yours faithfully,
"INTERESTED."

FOOD MANUFACTURE INDEX FOR 1940

THE 1940 index of FOOD MANUFACTURE is still available, and copies will be sent to subscribers on receipt of a stamped addressed envelope. This envelope should be 10 inches by 8 inches to avoid undue folding of the Index.

TRANSMISSION OF POWER

The efficient and regular transmission of power from one shaft to another is one of the most important factors in economical management. From the point of view of an engineer in charge selecting a drive for some installation he is making, his final selection will be based upon a very careful consideration of efficiency of transmission; liability to breakdown and attendant consequence; initial cost of installation; and upkeep charges.

P. W. PEEL

IN EVERY factory where motive power is used some means must be provided for transmitting the power from its source to each individual machine which requires power.

It is not the intention in this article to deal at length with any particular system or to recommend any form of drive, but rather to outline the fundamentals of some drives.

In seeking a solution to his problems the power user must give careful thought to the advantages claimed for the respective forms available, applying them to his specific requirements.

There are several well-defined methods of assisting the power user in his transmission problems. The most important are as follows:

Belting: Leather, rawhide, rubber, cotton, balata, steel, cotton-hide.
Rope driving.
Chains.
Toothed gearing.
Direct coupling, flexible couplings.

For short drives, where the distance between the driving and driven pulleys is insufficient to give the arc of contact necessary for efficient transmission, "vee" belts are becoming increasingly popular.

Other apparatus, such as shafting, clutches, hangars and pulleys, are used in combination with the above means.

Drive by Belting

The most widely known form of transmitting power is by belt. Unfortunately, the popular conception of a belt drive is a couple of pulleys and a belt, and away you go.

Belt drives *can* be used to advantage in many places, but they should never be put in without considering all the factors, such as type, speed, width, tension and life of the belt, size and surface of pulleys, and construction of the bearing. Small pulleys shorten the life of belts, narrow belts are apt to slip, which is a big factor in belt deterioration. Small pulleys and narrow belts also require excessive belt tension, which puts a strain on shafts, pulleys, belts and bearings. Overhung pulleys should be used only for small powers and with light belts.

While first cost should not be regarded as the determining factor in the choice of belting, due consideration must, of course, be given to this item, and in certain circumstances may dictate that it shall be the deciding factor.

Varieties of Belting

The kind of belting selected depends greatly upon conditions of drive, distances, etc. For the ordinary short drives leather is the most desirable, though when power to be transmitted is small, rawhide belts are also satisfactory, especially as the cost is less than for leather belts. For considerable distances rope driving is successfully used. The most suitable conditions are those in which the drive is horizontal and the centre distances round about 50 ft., since under these conditions the weight of the rope itself is sufficient to give what initial tension is necessary. There is to-day an increasing application of ropes of special section and composition capable of efficient transmission over a very wide range of centre distances, from long to very short, but with these we are not at the moment concerned.

Rubber belts are used to advantage in driving generators from water turbines, where the belt might be exposed to moisture.

Leather belting is usually the most reliable and satisfactory for general application, except for very short drives. There are three thicknesses of leather belting: single, double-light and double. For use in connection with generators, motors or other high-speed machinery the "light-double" belting is usually the best.

Power Transmitted

The exact amount of power that a given belt is capable of transmitting is not very definite. The ordinary rule is that single belt will transmit one horse-power for each inch of its width when travelling at a speed of 1,000 ft. per minute. This statement of horse-power transmitted is based upon the condition that the belt is in contact with the transmitting pulley around one-half of its circumference, or 180°, which is usually the case. If the arc of contact is less than 180°, the power transmitted is less in the following proportions: an arc of 135° gives 84 per cent., while 90° contact gives only 64 per cent., of the power derived from a belt contact of 180°. If, on the other hand, the upper side sags downward, which is always desirable, the belt is in contact with more than half the circumference of the pulley, and thus the grip is considerably increased and more power can be transmitted. These facts make it very desirable to have the loose side of the belt on top.

Belting formulæ are only approximate and should not be applied too rigidly, since the grip of the belt upon the pulley varies considerably under different conditions of tension, temperature and moisture. The smooth side of a belt should always run against a pulley, as it transmits more power and is more durable.

How to Choose a Leather Belt

When a works engineer decides to buy a leather belt, instead of being at the end of his thinking he is really only at the beginning of it. He must then decide what kind of belt he shall buy.

In considering this the first step is to set down just what qualities are necessary in a leather belt in order to make it worthy of purchase. It must be strong and tough, it must be sufficiently elastic to absorb the shocks of fluctuating loads, it must be able to elongate and return to first length without undue heating, it must be free from stretch, it must be light and pliable, it must be easy to lengthen and shorten, it must be free from slip, and it must have a high tractive quality.

With these things in view, the next step is to take the various belts under consideration and see how many of the required conditions they can fulfil. One may be strong on many points but noticeably weak on one of two points of major importance. Another may be strong on a very few points, but these may be of value on final analysis. The art of selection consists of finding the belt that measures up to the greatest number of important requirements.

From this study the first choice of the most likely candidates for the purchase can be made, but then even the final work is not accomplished. The reptutation for service that belts of similar make have earned must be considered. Durability is of such importance that it cannot be overlooked, and, since it is next to impossible to forecast the length of life that an untried belt will give, the intending purchaser must carefully search the records of other belts made by the same maker.

Having thus selected the brand and make of the belt, consideration must be given to the conditions under which it must run. The presence of steam, fumes or excessive moisture will call for one kind of a belt. The absence of these will suggest the selection of another kind. Also the length, speed and type of drive must be considered. Weight and width must be balanced against speed and type of drive, and from that the final choice made.

As to the cost of such a belt, nothing can be said; obviously if you get a belt that will answer all the necessary conditions and will fit the requirements from every point of view, it is cheap at any price within reason. For in the final analysis the value of a belt is not what the purchaser gives for it, but what it gives the purchaser in return for his money.

Combination Leather Belts

These belts are of several types, and comprise in general two compound parts, leather and another material. In all cases the leather face is used for frictional purposes, and should, therefore, be run next to the pulley, while the remaining component is used to take the strain of the drive. One of the most popular is a combination of balata and leather, the two materials being glued together and reinforced with rows of copper stitching. In a similar manner a combination of leather with hair or solid woven cotton is used. Strips of leather spaced apart either across the width of a balata belt or along its length form two types of combination belts in use, and these claim exceptionally high frictional qualities and a greater degree of flexibility than are possessed by other types of combination belting. Combination belts are essentially useful on slow, slogging drives, where their heavy weight gives added pull to the drives.

The "V" Rope

The application of the "V" rope has become widespread. As a semi-positive drive at close centres it may be a rival to the chain or toothed gear. Closely examined, it consists of a composite of cotton yarns and rubber formed into a V section and woven so as to constitute an endless circle of any length or thickness required. A drive may be composed of two, three or more ropes, manufactured of the size determined by the length between the driving and driven pulley centres and the power to be transmitted. There is no jointing and consequently no variation in the thickness and flexibility of the ropes composing the drive. Solid and flexible, the ropes naturally cling to its supporting pulley and bend to a very narrow radius. Because of these latter characteristics, this form of drive can be used for very short centres, with the driving and driven pulleys as close together as possible without touching. It will be appreciated that V rope has a very wide range of applicability.

The Chain Drive

The eminence which the use of chain driving has attained for the purposes of power transmission in all branches of engineering may perhaps be attributed to the wider appreciation of the inherent advantages possessed by this type of drive. The established claim of the chain drive to give an efficiency of 98 per cent. in well-designed drives makes it a medium which calls for careful consideration when planning drives.

The drive is positive—*i.e.*, no slip can occur between driving and driven pinion—and can be run at centres so short that the wheels just clear, and allow of great accessibility. In addition they make possible the use of small high-speed motors with their consequent advantages.

This type of drive has been installed for transmitting power from electric motors to line shafts and counter-shafts, in industries where the necessity for increasing efficiency and continuity of production has been dictated by the economic situation, and where quietness and absence of vibration is essential. It is not affected by atmospheric conditions, operating equally well in hot, cold, damp or oily places.

Conclusion

For the most part, development in drives and transmissions has proceeded along lines already well defined. Generally the object is to bring the source of power as near as possible to the point at which it is required, and consequently the multiplication of motors continues. Multiple V belts are increasing in popularity, while attention may also be drawn to the extending application of helical gears. For right-angle drive, spiral bevel gears are finding favour.

PROTECTION OF FOODSTUFFS AGAINST POISON GAS

THE Ministry of Food is issuing to the food trades and those responsible for the storing of food supplies the following instructions as to the action which should be taken for the protection of foodstuffs against contamination by poison gas:

The risk that foodstuffs may be contaminated by poison gas is a real one. Those responsible for the handling of food should be fully alive to the danger. Contamination may remain undetected for a time and lead to considerable loss of foodstuff unless every precaution is taken.

Gas sprayed from aircraft may take twenty minutes or half an hour to fall. It will be very difficult to say where the danger will be or for how long it will last. Foodstuffs exposed in the open may be seriously contaminated.

Foodstuffs should be protected continually, therefore, especially where they are not in cans or other sealed containers. *Meat, sugar, grain, flour, fats, bread, fruit, vegetables, feeding-stuffs, etc., must be kept covered at all times.*

Wherever possible, foodstuffs should be kept under shelter and not stacked in the open. They should be given protection during handling at every point where they are normally exposed in the air. The only safe rule is to keep foodstuffs covered continually.

Tarpaulin sheets of the oil-dressed type offer the best temporary protection for foodstuffs in the open, and should be used wherever possible. If these are not available, screens should be improvised with canvas, sacking, corrugated iron, etc.; if possible these screens should not be in direct contact with the foodstuffs. Anything which gives shelter will help to guard against the danger of contamination.

In warehouses, etc., foods in sacks or other permeable containers should, wherever possible, be stored in middle floors and away from windows. Additional protection can be given to a stack by the use of tarpaulin covers or screens of canvas, etc. Meat inside cold stores and refrigerators is perfectly safe from poison gas.

The greatest caution is essential; lack of preparation may cause endless trouble. Loose waterproof sheets or other covers should always be kept at hand and not wasted on work less important than the protection of food supplies.

If food is affected by poison gas it should be examined by the authorised officer of the local authority, who will decide whether it can be decontaminated on the spot, or if it is necessary to remove the food for decontamination elsewhere, or for destruction.

EXPORTS TO BRAZIL, CHILE, PERU AND COLOMBIA

MANY complaints have been received regarding the effects of the Export of Goods (Control) (No. 6) Order, which applies licensing procedure to exports to Brazil, Chile, Peru and Colombia.

The Board of Trade fully realise the difficulty and inconvenience caused by this Order, and would not have made it if there had not arisen a situation which required drastic treatment. They fear it will be necessary to maintain the Order in force, and exporters may find it useful to have the following indication of the main principles underlying the direction of exports and the present practice of the Export Licensing Department so far as concerns goods which were added to the Export Prohibited List by the Order in question.

As the President of the Board of Trade has pointed out, not all exports are equally valuable in present conditions. The United Kingdom is using a great quantity of materials, productive capacity and labour on manufacture for armaments, and can only use them on manufacture for exports if the exports are necessary to secure indispensable goods. Desirable exports fall into three classes:

(1) Exports to countries with dollar currencies or whose currencies can be readily converted into dollars;
(2) Those exports to the sterling area which fulfil requirements that would, unless supplied by the United Kingdom, involve those countries in payments of dollars;
(3) So far as raw materials, capacity, labour, shipping and other considerations permit, a regulated modicum of trade with friendly countries all over the world.

Exports to the four countries affected by the Order, so far as they are desirable at all, fall into Class 3, and the necessity to limit them by export licensing procedure arises from the limitation of imports into the United Kingdom to those which are indispensable, a situation which has developed rapidly since the Willingdon Mission went to South America several months ago. A large part of the goods normally imported from South and Central America are not indispensable in present circumstances. His Majesty's Government have, in fact, made large special purchases in view of the desperate sterling position; but there is a limit to such a policy, and it is not reasonable that this country should purchase commodities which it does not need and perhaps can only ship with great difficulty, for the sole purpose of providing sterling for the payment of goods which are often in short supply and had much better be directed elsewhere. In

these circumstances, notwithstanding the inconvenience and embarrassment, both to exporters and to importers in the countries concerned, exports to these countries must be restricted (in varying degrees) if only for the purpose of ensuring that such exports as are possible will be paid for and outstandings liquidated. Some exporters have said that whether they get paid now or later is their affair. The Board cannot accept this argument. In view of the demands on the limited supplies of raw material, manufacturing capacity and labour available, it is essential that exports in the national interest should be directed to destinations where a good return will be obtained now. Moreover, experience shows that a country in which heavy outstandings have piled up generally resorts, in the long run, to a funding arrangement, which means either that the United Kingdom exporters concerned have to wait several years for their money or the debt is merely transferred to other shoulders.

The following is a summary of the present practice of the Export Licensing Department so far as concerns goods which were added to the Export Prohibited List by the Export of Goods (Control) (No. 6) Order, 1941 :

Goods included in Lists A and B of the Export Control Order, and therefore subject to licence on export to these and other destinations independent of the No. 6 Order, will continue to be dealt with as heretofore.

It is impossible to state in detail whether or no licences will be granted for particular commodities to specified countries, but the following shows in general terms the present licensing position of goods which are brought under control by Order No. 6.

Brazil: Licences are at present being issued fairly freely for the export to Brazil of articles which have a high value in comparison with that of the material and where little or no imported material is used.

Chile: Exports to Chile have been on such a high level in comparison with imports from that country that it is necessary to restrict exports to this destination severely.

Peru: For the time being licences can only be issued in altogether exceptional circumstances. It is, however, possible that the position will change and that within a few weeks' time a less severe restriction will be possible.

Colombia: Licences are being issued freely for goods on the Colombian Class 1 List. For goods in other classes licences may be issued in exceptional cases, but evidence will normally be required that the goods are being paid for in U.S.A. dollars or in sterling not bought on the free market.

It has been found possible to issue licences to meet certain special cases in all the above four countries :

(*a*) Where evidence, normally by banker's certificate, is produced showing that the goods will be paid for by sight draft or through an irrevocable credit, or have already been paid for by cash in this country.
(*b*) Goods despatched from the factory before the control came into force on March 6.
(*c*) Goods such as machinery specially made for the destinations in question where it is impossible for applicants to dispose of them in other markets.
(*d*) Goods not for resale, but for plant which is producing basic commodities or for railways or essential public services.

It is regretted, however, that it is not practicable to allow export to these destinations merely on the ground that goods have been made to an order from these countries. It is clear from the applications made to the Export Licensing Department that such a concession, apart from the inherent difficulty of administering it, would delay very materially the object which it is hoped to obtain by the Order.

UTILISATION OF WHEY

In order to derive the maximum benefit from the heavy production of milk during the ensuing months, arrangements have been made to convert as large a proportion of milk as possible into those products which will keep and so be available to augment food supplies next winter, according to a joint announcement by the Agricultural Departments and the Ministry of Food. Cheese-making on an enlarged scale will be undertaken, and the resultant whey will be condensed or dried for ultimate use for human consumption or as calf food, to the full capacity of available plant. Surplus whey must be used for stock, and in order to facilitate this economic method of disposal the following scheme has been approved, involving, in some instances, increased allowances of cereal feeding-stuffs for pigs :

1. Creameries and cheese-making factories will be given, in lieu of the ordinary rations for their pigs, 28 lb. of cereal feeding-stuffs per month for each pig kept by them in June, 1939, unless since that date whey drying facilities have become available. As 24 lb. per month is considered an adequate allowance of cereals for whey-fed pigs, the allowance of 28 lb. should suffice to maintain during the cheese-making season one-sixth more pigs than in June, 1939.

2. Farm cheese-makers who are unable to process their whey or dispose of it for processing will be allowed feeding-stuffs on the same terms. If they did not keep pigs in June, 1939, as may be the case if they are making cheese for the first time, farm cheese-makers will be allowed 24 lb. per month for each pig being kept to consume whey.

3. Creameries and cheese-making factories having a surplus of whey which cannot be processed or consumed by their pigs under the above arrangements will offer to supply or to make a contract with any farmer or pig-keeper willing to purchase the surplus whey at a price not exceeding ⅜d. per gallon at the creamery.

4. When farmers' requirements have been so ascertained, creameries and cheese-making factories still having a surplus of whey will be allowed 24 lb. of cereal feeding-stuffs per month for each pig additional to those reckoned to be provided with rations under paragraph 1 above.

5. Applications for ration coupons should be made monthly to Agricultural Executive Committees, accompanied by the relevant information, including a declaration on the first occasion that the applicant commenced (or will commence) making cheese on a specified date this season, and will continue to make cheese during the month for which the coupons are required.

RESERVED OCCUPATIONS

The new Schedule of Reserved Occupations in connection with the calling up for service in the Armed Forces introduces a new system, there now being three classes concerning age limits : (A) applying from April 10, 1941, and (B) and (C) at later dates. Exact dates under (B) and (C) have yet to be issued, but it is stated that men de-reserved under (B) will not join up before July 15, 1941, under (C) before October 1, 1941, and men de-reserved under (A) will not join up before June 1, 1941. Medical examination, however, may be required to be undertaken before these dates.

But there is another important alteration in procedure, as now instead of occupation and age being the deciding factor for reservation, the new system provides that not only the national importance of the occupation, but the actual work being done, will be taken into consideration. It may be found that some men of the same occupation, if engaged on what is known as " unprotected work ", will be liable for service, whereas others will be exempt—that is, at an earlier age—if considered in " protected " work. As an example, the reserved age for men on " protected " work may be 25 years, men on " unprotected " work 35 years, although of same occupation, the position being that such men under 35 years will be liable for service; on " protected " work only men under 25 years will be liable to be called up.

The Ministry of Labour has formed a Register of Protected Establishments, and employees of concerns accepted for this Register will be automatically considered on protected work and reserved at the lowest age of reservation for the occupation. But if there are two ages of reservation for the same occupation (*e.g.*, 25 protected, 35 unprotected), the employer must apply for reservation of each individual over the lower age to be reserved at that age, otherwise the employee may receive an enlistment notice.

Matters to Note

It should be fully understood that the Schedule only applies where there is an occupation included, with a reserved age different from the ages of the National Service (Armed Forces) Act (that is, 18 to 40 inclusive), and that where no reference is made to an occupation, that occupation is not reserved at any age, the ages of the Act applying.

At present five groups of trades are named officially for the Register of Protected Establishments, but this does not mean that concerns outside these groups are not to be admitted, but there must be special reasons for inclusion.

Animal fat processing, bacon curing, bread-making, cold storage and food warehousing, fish curing and preserving, fruit and vegetable preserving, grain milling, margarine and edible fat compound manufacture, meat preserving, milk processing, sugar manufacture and refining and glucose production, and yeast manufacture for bakeries come under Group A.

NEWS FROM THE INDUSTRY

Divisional Food Organisation

The Minister of Food has appointed Mr. R. H. Beckett, C.S.I., C.I.E., to be Divisional Food Officer, South-Western Division.

* * *

Appointment of Wholesale Trade Adviser

The Minister of Food has appointed Mr. C. E. Davies to be Wholesale Trade Adviser to the Ministry of Food. Mr. Davies will be attached to headquarters of the Ministry, and will deal with problems arising out of wholesale distribution.

Mr. Davies is a member of the firm H. H. and S. Budgett and Co., Ltd., of Bristol. He has been serving as Chairman of the South-Western Area Provisions and Groceries Committee and as a member of the Bristol Port Emergency Committee, and is ex-President of the Bristol and West of England Wholesale Provision Trade Association. He was recently elected Vice-Chairman of the National Committee of the Wholesale Provision Trade and a member of the Co-ordinating Committee of the Provision Exchange of the United Kingdom.

* * *

Licensing of Preserve Manufacturers

The attention of manufacturers is drawn to Article 4 of the Jam, Marmalade, Syrup and Treacle (Control and Distribution) Order, 1941, which required all manufacturers of jam, marmalade, syrup and treacle to be licensed by the Ministry before May 1, 1941. Manufacturers of these products must apply for licences to the Ministry of Food, Jam Section, St. John's College, Oxford.

* * *

Control of New Potato Prices

Prices of all new potatoes sold in the United Kingdom were controlled from May 17 onwards. Maximum prices prescribed on sales by growers, by wholesale and by retail are set out in the New Potatoes (Maximum Prices) Order, 1941, Statutory Rules and Orders, 1941, No. 639, Emergency Powers (Defence) Food (Potatoes), dated May 10, 1941.

The quantities of new potatoes coming on the market before this date were very small, and were chiefly of hothouse production.

* * *

National Straight Run Flour: Increase in Rate of Extraction

The Minister of Food has made an Order amending the Flour (Prices) Order, 1940, by substituting the figure 75 per cent. for 70 per cent. in the definition of National Straight Run Flour. This Order requires millers to produce not less than 75 per cent. of the weight of the products of the milling of wheat in the form of flour.

Although the previous Order required a minimum of 70 per cent. extraction, this had been amended administratively to 72 per cent. The increase in the rate of extraction will therefore be only 3 per cent. and will be barely perceptible. It will, at the same time, effect a valuable saving in the use of wheat and economy in the shipping space required for its importation.

* * *

Slicing of Bread

The Scottish Association of Master Bakers, the Glasgow and West of Scotland Master Bakers' Association, and the Scottish Co-operative Baking Association, representing the Scottish Co-operative Societies, decided to stop the slicing of all bread throughout Scotland from April 12. This decision was taken after consideration was given to the various difficulties involved in the slicing of bread under war-time conditions. Only in cases of urgency, such as for communal feeding centres, canteens, etc., will loaves be sliced. Wrapped bread, however, will still be available.

* * *

Cumming, Parsons, Ltd., Staff

Mr. J. B. Millar, M.P.S., who has been covering the North-Eastern Counties, has been called to the colours, and is serving with the Signal Corps.

Mr. T. D. Tait, who has for some time past been representing the firm in the South-West Counties, has now joined the Royal Air Force.

Mr. A. MacDonald has been promoted to Sergeant-Inspector in the R.A.S.C., and is keeping very fit.

No doubt their many friends in the trade will be interested to hear of their well-being, and they have asked to be kindly remembered to all their friends.

Cumming, Parsons, Ltd., are retaining the services of these gentlemen whilst they are with the Forces, and look forward to the time when they can resume their occupation with them.

* * *

Emergency Legislation Service

This service, inaugurated at the commencement of the war by Butterworth and Co., Ltd., is designed to cover effectually all Emergency Acts of Parliament and Regulations issued thereunder. The service is in two parts:

Statutes.—They comprise all Emergency Acts of Parliament completely annotated, classified and indexed. This service up to the present consists of the first volume (700 pages) and six Supplementary Volumes containing additional Acts.

Rules and Orders.—This part of the Service consists of the frequent issue of classified, annotated and indexed Rules and Orders issued under the Emergency Acts. They are contained in three loose-leaf binders. All Services so far issued are arranged in order in the binders before despatch to subscribers so that all it is necessary to do is to insert future issues as instructed. The cost of the above up to the end of the fifth quarter's Service (November 30, 1940) is £7 18s. 6d., plus postage. The price of current quarter is 28s. 6d., plus postage. New Statute Supplementary Volumes (when issued), 5s. each, plus postage.

X-Ray Analysis in Industry

The earliest application of X-ray analysis was to the determination of the atomic arrangement in crystalline structures, and this work has had far-reaching results in many branches of science. Of recent years this powerful tool of the physicist has been used to investigate many other characteristics of the solid state, such as the identification of crystalline constituents of minute samples, the structure of alloys, the identification of intermediate products in chemical processes, the identification of allotropic changes in refractories and the determination of sub-microscopic crystal size and orientation. A new field, hardly explored at all as yet, is that of the sub-microscopic structures within each individual crystal, such as occur in age-hardening and other types of imperfect phase precipitation in the solid state. Such structures profoundly influence physical properties and hence are of great interest.

The importance of this subject, particularly for the present war effort, has led to a widely expressed desire for closer collaboration and sharing of experience between those concerned with the subject. This desire is being met by the publication of a series of papers invited by Sir Lawrence Bragg, President of the Institute of Physics and a pioneer in this field, and will be published by the Institute in two special issues of the *Journal of Scientific Instruments* (which journal is now partly devoted to the applications of physics in industry). Each of these numbers will be enlarged to double the normal war-time size; the first group of papers were published in the May issue and deal with the applications of X-ray methods as applied to a wide range of industrial problems. The second group, which will appear two or three months later, will deal with the technique of the methods and some recent developments.

Copies of these special issues may be obtained, price 2s. 8d. each post free.

* * *

Travelling Canteens for Forces

The experimental train canteens for troops introduced by the L.M.S. Railway between London and Glasgow and *vice versa* in conjunction with the War Office, Y.M.C.A. and Salvation Army authorities, are to become a permanent feature on certain express trains between these two points.

These canteens will serve hot drinks, sandwiches, meat-pies, biscuits and chocolates at popular prices.

* * *

Royal Sanitary Institute

At the Annual General Meeting of the Royal Sanitary Institute, held on April 25, the Right Hon. the Earl of Bessborough was elected President of the Institute in succession to Lord Balfour of Burleigh, whose period of office had expired.

The Reazurin Test

Of outstanding interest during the past year has been the development of the Resazurin Test for detecting poor quality milk. Much has been written about this test from milk laboratories, and the test has aroused considerable interest. The Tintometer, Ltd., in conjunction with Dr. J. G. Davis, of the National Institute for Research in Dairying, and Mr. S. B. Thomas, of Aberystwyth College, has designed a special comparator and disc of colour standards for use with the test, in order to simplify procedure and increase accuracy.

Those laboratories which already have the All-Purposes Lovibond Comparator for the Phosphatase Test, however, need only add the stand, disc and test tubes.

Many new discs for chemical determinations have been added recently to the list of Lovibond Comparator discs, and the choice is now so comprehensive that space does not permit a full survey. The manufacturers' publication L.92 includes an index of tests available.

Fused glass cells and colorimeter cups are now in full commercial production at this factory, of such a quality as to give one high hopes of keeping the continental makers off our markets after the war.

* * *

Standardisation of Colour in Foodstuffs

The most important means of direct colour measurement is provided by the Donaldson Trichromatic Colorimeter originally developed at the National Physical Laboratory, made by Adam Hilger, Ltd. With it all colours may be measured and specified in terms of the internationally recognised C.I.E. system of colour measurement. The material whose colour is to be measured is inserted in a holder and illuminated by a carefully standardised light source under precisely controlled conditions. An observer at the colorimeter sees the colour occupying one-half of the field of view, and by manipulating simple controls he produces in the other half a colour which exactly matches that of the specimen. These controls regulate the amounts of light passed by three colour filters into a device which adds them together to form a colour whose composition can be stated in terms of the filter openings. The measurements are made quickly after a little practice, and are readily converted to the C.I.E. form with a minimum of arithmetical work.

On account of the wide use of nearly white materials, their colour measurement and discrimination are of great importance. For such instances the Hilger Blancometer is especially useful. This is a photo-electric instrument of great sensitivity and is the subject of British Patent No. 32451/1928. In its use the light is received by a photo-cell after passing through specially prepared colour filters, and the resulting current is measured by a null method. By a simple calculation the measurement of the colour in C.I.E. units may readily be found from the readings. The instrument is several times more sensitive than is the human eye and has important applications to the measurement of nearly white colours and to differential colour measurements.

* * *

Temperature Regulators

Sarco Temperature Regulators find application in the canning industry on exhauster boxes, process tanks, cooking pans and vats, store-rooms, and for control of room temperature in the factories themselves. The regulator is a self-acting thermostatic valve suitable for steam- or hot-water-heated plant and for cooling by water or brine. The thermostat or temperature sensitive element and the valve are connected by a fine-bore copper tube, which terminates at the valve end in an element containing a plunger which operates the valve. The regulator system—thermostat, connecting tube and valve-closing element is filled with a temperature sensitive liquid.

When the thermostat is exposed to heat the liquid expands, creating a powerful hydraulic force which moves the plunger in the valve-operating element, closing down the valve and reducing the flow of heating medium. This movement is proportionate to the rise in temperature, so that when temperature fluctuations are small the valve takes up a throttling position, which allows just that amount of heat to pass which will maintain the required temperature. Any variation in the demand for heat is immediately detected by the thermostat, which moves the valve towards the open or closed position as required, thus counteracting a rise or fall in the temperature being maintained.

The regulator is entirely self-acting and requires no outside source of power such as electricity, air or water under pressure for its operation. It is therefore simple to install, and there are no running costs.

The employment of liquid in place of a volatile fluid as the operating medium ensures positive and ample power, even at low temperatures. The power generated per degree of temperature rise is the same at cold-storage temperatures as at boiling point. The makers are Sarco Thermostats, Ltd.

* * *

Flavouring Essences

Now that so many substitutes have to be used in foods, flavourings are more necessary than ever; just as a pinch of salt improves flavour in some foods so does a spot of vanilla in others give increased satisfaction. As most essences have advanced in price owing to the increased duty and cost of spirits, the product known as Vanoleum, made by Arthur Whittaker, would appear to be useful owing to the fact that it is soluble in hot water, thus avoiding the use of alcohol.

* * *

Lt.-Col. Maurice W. Batchelor

Maurice W. Batchelor, joint managing director of Batchelor's Peas, Ltd., is now a Lieut.-Colonel in the Royal Army Ordnance Corps.

OBITUARY

Mr. Duncan M'Grouther

The death has occurred at his residence, Craigview, Cornton Road, Stirling, of Mr. Duncan M'Grouther, managing director of Messrs. M'Grouther, Ltd., Scottish Bacon Curing Factories, Stirling and Aberfeldy, who was a prominent member of the bacon-curing trade in Scotland. He was 57 years of age.

Mr. M'Grouther did a great deal of pioneering work in the direction of improving the type of bacon pig required by the factories. A number of demonstrations for the benefit of pig-breeders were arranged by Mr. M'Grouther at the Stirling factory, where carcass competitions were also held.

* * *

The British Food Mission in U.S.A.

Mr. J. G. Hopkins, of A. J. Mills and Co., London and New York, has been appointed a technical representative of the British Food Mission at Washington. Mr. Hopkins has been engaged for nearly twelve months on work in the United States for the Ministry of Food.

* * *

Mixers

A mixer claimed to effect the distribution of ingredients in less time and with less power than formerly is the Beken "Duplex" Mixer, the makers of which are E. Hunt and Co., Ltd. Embodying an entirely new principle, a unique method of blade intermeshing makes the machine efficient for all types of mixing and in particular for stiff pastes and doughs. We have received a well-produced booklet describing the different types made.

* * *

Bournemouth Markets Ice and Cold Stores

Net profit for 1940, £2,389 (£374); to tax reserve, £500 (nil); dividend, 3 per cent. on 7½ per cent. non-cumulative preference (nil); forward, £3,940 £2,566).

* * *

Smith's Potato Crisps Again Pay 32½ per cent.

Smith's Potato Crisps (1929) is again paying a final dividend of 20 per cent. and a cash bonus of 5 per cent., making 32½ per cent., less tax, for the year to March 31. This is the same rate as for each of the three preceding years. The 5s. shares are quoted at 28s. 3d.

* * *

Derbyshire Fruit Canning Scheme

A scheme has been evolved for canning the surplus produce of Derbyshire gardens and orchards so that it will be available for the growers' personal use during winter months.

Co-operating in the scheme are the Duchess of Devonshire, Mrs. E. H. Gasking (Chairman of Batchelor's Peas, Ltd., Sheffield) and the Derbyshire Federation of Women's Institutes.

INFORMATION AND ADVICE

Pickling Red Cabbage—Frosting in Honey—Information Supplied

Pickling Red Cabbage

7,240. *We shall be glad for information on the best method of pickling red cabbage. We have been packing this product in small jars and the cabbage does not keep fresh for very long. We use spiced malt vinegar and pack after the cabbage has been salted overnight.* (Vancouver, B.C.)

As a basis for trial you might try the following method:

See that the cabbage is fresh. Strip off any discoloured outside leaves. Using a stainless steel knife or a shredding machine of stainless steel, cut up the cabbage into a 50-gal. cask. This should take four 1-cwt. bags of cabbage. Now place on top of the cabbage 28 lbs. of bay or dairy salt, fill the cask with cold water and allow it to stand overnight. It is important to see that the brine is quite free from iron, otherwise the colour of the pickled cabbage will be darkened. If the water is delivered from an iron pipe, allow it to run for a few minutes before using. It is best to test the water for iron content.

Next day drain away the brine, either by turning over the cask or by taking out the cabbage in baskets. Mix the well-drained cabbage with 4 ozs. mixed spices (whole ginger, allspice, chillies) and fill up with 80 per cent. acetic acid (3¾ gals. in 46 gals. of water) or 24 grains pale malt vinegar. (Never use vinegar that has been coloured.) The cask should have 22 gals. of vinegar to 4 cwts. of cabbage. This is a very important point, for if there is not enough the cabbage will be soft and limp, whereas if there is too much the cabbage will be too sour.

Close the cask and stand in a cool place (with a temperature never over 80° F.) for 10 to 14 days before using.

The important points to observe, if it is desired to obtain a crisp cabbage of good colour, are: Make certain that there is no possibility of the cabbage or the vinegar being contaminated with even a trace of iron. The same warning applies to alkalies; the water used in brining and for bottle-washing purposes must be free from alkalis. Another point is that all cabbage should be kept as much as possible in the dark.

Frosting in Honey

7,171. *Would you be good enough to let us know as soon as possible if you know of any method to prevent frosting in granulating honey? We should also be glad if you could forward us the names of manufacturers of small electrical labelling machines.* (Leeds.)

Frosting in honey is due to a special kind of crystallisation (distinct from that causing ordinary granulations, that is). Like other slow and progressive crystallisation processes that originate from a nucleus or "seed", it cannot be controlled once it has started. It may, apparently, be prevented from starting by using care, during processing the honey and filling it into bottles, to exclude air. Frosting is absolutely harmless. It is stated to reduce the value of the honey because customers are suspicious of it, thinking it shows some undesirable change has set in. This fear is unfounded, and some customers prefer the frosted honey as having greater eye appeal.

Here is a summary of a paper by R. H. K. Thomson on "Granulation Problems in New Zealand Honey" (*New Zealand Journal of Science and Technology*, Vol. 19, 1937-38, pp. 714-720):

(1) Physical determinations on a limited number of "frosted" and normal granulated honeys show that the frosted areas contain δ-glucose crystals of smaller diameter than those in normal honey. The colour of frosted and normal honeys is directly related to the mean diameter of the crystals.

(2) Under laboratory conditions frosting has been induced by the presence of air bubbles in the honey. In the absence of air bubbles no frosting occurred.

(3) Contraction of volume occurs during granulation of honey. The change of volume during granulation at 25° C. has been determined for four typical honeys. The data obtained for one honey are presented. The volume changes may be expressed by the formula—

$$c = k \log t,$$

where c is the observed contraction, t the time elapsed, and k a constant.

Also from text, p. 720: The contraction in volume of honey during granulation suggests the possibility that frosting is influenced by the retreat of the liquid phase of honey from between the glucose crystals.

"Frosting" is also known as *dry granulation.*

Information Supplied

6,558. *We shall be much obliged if you can give us the name and address of the makers of Viota Food Products.* (Nottingham.)

This was done.

6,564. *Could you put me in communication with a firm or firms which manufacture confectionery machinery?* (Jamaica.)

This was done.

6,570. *I shall be extremely grateful if you can let us know where we can obtain supplies of paper bags as per sample enclosed.* (North Shields.)

Some names were given.

6,576. *We want to extract the kernel from apricot stones, and shall be glad if you can recommend to us suitable firms who are manufacturing such a machine, or perhaps put us in touch with people who are actually doing the cracking and extracting the kernel themselves. We should imagine that such a machine as used for cracking almonds would be the right type, as we wish to extract the kernel whole.* (London.)

Some suggestions as to suppliers were made.

6,602. *We are just installing a filter press for bleaching digestor fat. Could you please tell us where we can obtain supplies of fuller's earth for the purpose?* (Burton-on-Trent.)

This was done.

6,614. *Could you please give us some advice on the manufacture of Saccharin Tablets? What materials are usually used as excipient? Is there any shortage of the material so used? What machines would you recommend as a complete unit for the preparing of the mixture to the completion of the tablets?* (London.)

We gave the name of a firm of suppliers of saccharin and also those making tableting machines.

6,622. *Referring to an article on "Mould Control in Bakery Products", we are interested in this line, and would be glad if you could give us the names of firms who are making the calcium propionate, as we would like to get into touch with them with a view to obtaining supplies of that article.* (Edinburgh.)

This was done.

6,630. *We desire to get in touch with suppliers of ordinary sausage casings and would be glad of any assistance you can give us.* (Trinidad.)

Names were given.

6,645. *We are enclosing a sample of powder for making the batter covering on the fish crisp. It is apparently mixed in a batter and the fish dipped into same. We should be pleased if you could inform us what this is likely to consist of.* (London.)

As this service does not include the analysis of samples, we recommended this enquirer to send his sample to an analyst.

6,659. *We have an enquiry from a customer for a material described Phospholac (we are not sure of this spelling). We should be glad if you could give us any information concerning the possible constitution of this product.* (London.)

So far as we can ascertain, this is a cake leavener known as Phos-fo-lac, manufactured by a U.S.A. firm (name given). We have no knowledge of the constitution of this substance.

RECENT PATENTS

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Abstracts of Recent Specifications

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume, or in bound volumes price 2s. each.

Improvements in or Relating to the Preservation of Foodstuffs

This invention relates generally to the preserving art, and more particularly to the preservation of fresh foods.

It has previously been proposed to enclose puddings in parchment paper or like or suitable material and to boil or steam the covered puddings in shaped moulds which can readily be taken apart. The cooked puddings enclosed in the parchment paper or the like were then to be packed in boxes.

An object of this invention is to provide a process which dispenses with containers such as tin cans and glass jars, and which utilises an inexpensive, lightweight, durable and attractive container in which such foods as vegetables, fruits, fish, shellfish, meats, fowl, etc., at present packed by either cold pack, open kettle or dry pack methods in expensive metal and glass containers, can be preserved indefinitely without deterioration.

Another object of the invention is to provide a preserving process in which an inner container directly receiving the food to be preserved is of such nature as to be structurally incapable of retaining its form during the cooking operation, and is confined in a structurally strong outer cooking container in a manner to be effectively supported thereby against such distortion, expansion or other dimensional or physical change as would cause excessive stretching, rupture or other structural failure of the inner container.

A further object of the invention is to provide a preserving process in which the inner food container is either placed in a carrier container or surrounded by a suitable liner in the cooking container to prevent the material of the inner container from sticking to the cooking container under the action of heat applied to the latter for cooking the product.

In accordance with this invention there is provided an improved process of preserving fresh food products, which comprises placing the cleaned fresh food product in an inner container of flexible, impervious material capable of being heat sealed, heat sealing the inner container airtight; placing the filled and sealed inner container in a rigid, closely confining cooking container, against the internal walls of which the inner container will be expanded under internal pressure resulting from boiling its contents; sealing the cooking container fluid pressure tight, and subjecting the cooking container to heat sufficient to cook the product in the inner container. It will be noted that during the cooking of the food products the closely confining inner walls of the sealed cooking container will limit the expansion of the flexible inner container resulting from the internal pressure developed by the food products being cooked, so that weakening or rupturing of the inner container will be prevented.

After the food products have been cooked within the inner container the cooking container is cooled and the sealed inner container is removed from the cooking container.

534,460. Duryea Bensel.

Improvements in or Relating to Wrapping Machines

This invention describes wrapping machines for wrapping articles of the kind having a longitudinal support for supporting the article to be wrapped, conveying means for advancing the article during the wrapping operation and wherein a wrapper is fed downwardly in a vertical plane across the path of the article being advanced, whereby the forward movement of the article disposes the wrapper against the advance end, top, and bottom of the article and against the sides of said artices to form an open-ended porch by means of tucking and folding elements, and having another support positioned at right angles to the first support, over which the article is advanced by a conveyor, other folding means being associated with one edge of the second support for tucking and folding the rearwardly projecting flaps of the porch so as to enclose the article completely within the wrapper and form a package.

The object of the invention is to provide an improved machine of the kind incorporating certain novel features of construction and operation in order to render the machine more simple and more reliable and efficient in operation than prior machines of this kind.

Another object of the invention is to provide a machine of the character described having the paper feed, cutting mechanism, and folding and wrapping mechanism so relatively constructed and arranged that the machine can be easily and quickly adjusted for use in wrapping packages of different sizes.

Acordingly the invention consists of an apparatus for wrapping articles of the kind referred to wherein the article is continuously advanced in a straight path over two spaced aligned supports, an endless carrier being provided for advancing the article along each of said supports, each carrier having a plurality of feeding elements mounted thereon and successively engageable with the articles, said two carriers and feeding elements being so relatively arranged that the two sets of feeding elements will operate without interference with each other, the folding and tucking means for folding the wrapper against the top, bottom, and sides of the article being associated with said second support.

527,952. Wilhelm Bertil Bronander.

Specifications Published

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, at the uniform price of 1s. each.

534,223. GURWITSCH, L.: Solidified edible fats, and the methods of manufacture thereof.
534,320. HALL, E. O. S.: Machine for cutting roots, vegetables and the like.
534,330. HOMMEL, G. W.: Storage of seed material and particularly cereals intended for consumption by human beings of animals.
534,393. MCKINNON AND CO., LTD., W., AND CARNIE, J.: Machines for extruding premier jus, suet, fat and like stuff.
534,460. BENSEL, D.: Preservation of foodstuffs.
534,416. BERKEL AND PARNALL'S SLICING MACHINE MANUFACTURING CO., LTD.: Machines for tendering meat.
534,503. CORN PRODUCTS REFINING CO.: Production of chlorinated starch.
531,223. INSTA-FREEZE CORPORATION: Devices for and methods of chilling or freezing liquid materials, for sample, confections or confection mixtures.
531,441. LIHOTZKY, E.: Centrifugal mixing-machine for dough and the like.
531,484. THORNTON, A. A. (CREAMERY PACKAGE MFG. CO.): Apparatus for mixing edible materials.
531,931. AKTIEBOLAGET SEPARATOR: Method of sterilising molasses used in the manufacture of yeast.
532,247. NAAMLOOZE VENNOOTSCHAP W. A. SCHOLTEN'S AARDAPPELMEEL-FABRIEKEN: Method of producing foodstuffs.
532,254. CROWN CORK AND SEAL CO., INC.: Mixing-apparatus for beverages.
532,255. CROWN CORK AND SEAL CO., INC.: Method of and means for mixing beverages.
532,378. STANDARD BRANDS, INC.: Method of manufacture of baked goods.

TRADE MARKS

The list of trade marks of interest to readers has been selected from the "Official Trade Marks Journal" and is published by permission of the Controller of H.M. Stationery Office. The journal can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, price 1s. weekly (annual subscription £2 10s.).

APEX.—613,397. Shredded suet and soup powders. **Stokes and Dalton, Ltd.,** Victoria Spice Mills, York Road, Leeds; Manufacturers and Merchants. To be Associated with No. 613,398 (3279) xxx. (By Consent.)

APEX.—613,398. Baking powder, cake mixtures, cereal puddings, flour, starch (for food), seasonings and gravy salts. **Stokes and Dalton, Ltd.,** Victoria Spice Mills, York Road, Leeds; Manufacturers and Merchants. To be Associated with No. 613,397 (3279) xxix. (By Consent.)

FRIENDSHIP.—613,481. Chocolates. **John Mackintosh and Sons, Ltd.,** Albion Mills, Waterside, Halifax, Yorkshire; Manufacturers.

KRASINE.—613,500. Foodstuffs for animals. Henry Curling Friend, Donald Henry Friend and Lynn Robert Friend, trading as **Couper, Friend and Company,** 33-35, Eastcheap, London, E.C. 3; Manufacturers and Merchants.

TOWN AND COUNTRY.—613,542. Confectionery and chocolates. Ernest Marshall, trading as **Copper Kettle Preserves,** Chester Walk, Cheltenham Spa, Gloucestershire; Manufacturer.

NEW COMPANIES

Northern Food Products Company Limited. (365099.) To carry on bus. of mnfrs. of and dlrs. in chocolates, confectionery and edible goods, etc. Nom. cap.: £500 in £1 shs. Dirs.: I. Fischhoff, 29, Sunbury Avenue, Newcastle-on-Tyne; Mrs. R. Fischhoff, 29, Sunbury Avenue, Newcastle-on-Tyne.

A. Bentley and Sons (Burnley) Limited. (365087.) To carry on bus. of dlrs. in and producers of fruit, potatoes, vegetables, etc. Nom. cap.: £3,000 in £1 shs. Dirs. appointed by articles: Abraham Bentley (Alkincoates Lodge, Colne) and Margaret Bentley. Abraham Bentley is permanent governing director.

Timinol Limited. (365106.) To carry on bus. of mnfrs. of and dlrs. in food products, etc. Nom. cap.: £100 in £1 shs. Dirs.: H. M. Schat, Holland House, Goodyers Avenue, Radlett, Herts; R. M. Stanford, 20, Harp Lane, E.C. 3; Mrs. G. I Crofts, 24, Lebanon Court, Twickenham, Middlesex.

Manor Farm Dairies (Hull) Limited. (365176.) 43, Welbeck Street, Hull. Nom. cap.: £1,000 in £1 shs. Dirs. to be appointed by subs. Subs.: D. M. Jones, 5, Beech Grove, Hull (acct.); J. W. Gibson, 5, Queensgate, Bridlington (acct.).